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Stillwater Mining Company
Nye, Montana

# Mine Expansion 2000 TPD
# Application to Amend Operating Permit No. 00118

# DRAFT ENVIRONMENTAL ASSESSMENT

December 1991

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Prepared by

Montana Department of State Lands
Montana Department of Health and Environmental Sciences
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TABLE OF CONTENTS


CHAPTER 1 - INTRODUCTION . . . . . 1
1.1 Project Location and Background . . . . . 1
1.2 Brief Summary of the Proposed Action . . . . . 3
1.3 Purpose and Need for Action . . . . . 3
1.4 Land Status . . . . . 4
1.5 Agency Roles and Responsibilities . . . . . 5
1.5.1 Department of State Lands . . . . . 5
1.5.2 U.S. Forest Service . . . . . 6
1.5.3 Other Federal Agencies . . . . . 7
1.5.4 Other State Agencies . . . . . 7
1.6 The NEPA/MEPA Process . . . . . 9
1.7 Issues and Concerns . . . . . 10
1.8 Issue Statements . . . . . 12
1.8.1 Tailing Impoundment . . . . . 12
1.8.2 Socio-Economics/Traffic . . . . . 13
1.8.3 Wildlife . . . . . 14
1.8.4 Surface and Groundwater Resources . . . . . 14
1.8.5 Wetlands/Flood Plains . . . . . 15

CHAPTER 2 - SUMMARY OF PROPOSALS, ALTERNATIVES, AND OTHER DEVELOPMENTS . . . . . 16
2.0 Introduction . . . . . 16
2.1 Development of Alternatives . . . . . 16
2.2 Alternative 1 - No Action . . . . . 17
2.3 Alternative 2 - Company's Proposal . . . . . 17
2.3.1 Mining Plans and Methods . . . . . 17
2.3.2 Explosives . . . . . 19
2.3.3 Production . . . . . 19
2.3.4 Ore Processing . . . . . 19
2.3.5 Tailing Disposal Facility - Impoundment . . . . . 20
2.3.6 Waste Rock . . . . . 20
2.3.7 Mine Water Use and Management . . . . . 20
2.3.7.1 Potable Water . . . . . 21
2.3.7.2 Stillwater River Water . . . . . 21
2.3.7.3 Adit Water . . . . . 21
2.3.7.4 Project Water Management . . . . . 23
2.3.8 Energy Consumption and Source . . . . . 23

2.3.9 Roads . . . . . 23
2.3.10 Equipment . . . . . 23
2.3.11 Surface Support Facilities . . . . . 24
2.3.12 Mine Utilities . . . . . 25
2.3.13 Security and Public Safety . . . . . 25
2.3.14 Sewage Disposal . . . . . 26
2.3.15 Solid Waste . . . . . 26
2.3.16 Fire Protection . . . . . 26
2.3.17 Personnel . . . . . 27
2.3.18 Project Closure and Reclamation . . . . . 27
2.3.18.1 Tailings Impoundment . . . . . 28
2.3.18.2 Grading . . . . . 28
2.3.18.3 Embankment Stabilization . . . . . 31
2.3.18.4 Dust Control . . . . . 31
2.3.18.5 Waste Rock Storage . . . . . 31
2.3.18.6 Soil Handling . . . . . 32
2.3.18.7 Revegetation . . . . . 36
2.3.18.8 Surface Facilities . . . . . 36
2.3.18.9 Mine Workings . . . . . 36
2.3.18.10 Facility Removal . . . . . 36
2.3.18.11 Mine Drainage . . . . . 37
2.3.18.12 Estimated Reclamation Units and Costs . . . . . 37
2.3.19 Water Resources Monitoring Plan . . . . . 37
2.3.20 Petition for Modification of Quality of Ambient Waters . . . . . 39
2.4 Alternative 3 - Modifications Concerning Tailings Impoundments . . . . . 41
2.4.1 Introduction . . . . . 41
2.4.2 Decision-Makers' Selection . . . . . 41
2.4.3a No Action - 3a . . . . . 41
2.4.3b Company's Proposal - 3b . . . . . 41
2.4.3c Partial Approval - 3c . . . . . 43
2.4.3d Modified Impoundment - 3d . . . . . 43
2.5 Alternative 4 - Water Treatment . . . . . 43
2.5.1 No Action - 4a . . . . . 44
2.5.2 Company's Proposal - 4b . . . . . 45
2.5.3 Advanced Water Treatments - 4c . . . . . 45
2.6 Proposed Action with Modifications - Alternative 5 . . . . . 46
2.6.1 Water Resources . . . . . 46
2.6.2 Tailing Impoundment Reclamation/Revegetation . . . . . 49
2.6.3 Waste Rock . . . . . 50
2.6.4 Soils . . . . . 50

2.6.5 Wildlife . . . . . 51
2.6.6 Aesthetics . . . . . 51
2.6.7 Traffic . . . . . 51
2.7 Other Related Development Activities . . . . . 51
2.7.1 Projects of Concern Evaluated (CNF) . . . . . 53
2.7.2 Projects of Concern Evaluated (GNF) . . . . . 56
2.7.3 Projects of Concern Not Evaluated . . . . . 58

CHAPTER 3 - AFFECTED ENVIRONMENT . . . . . 59
3.0 Introduction . . . . . 59
3.1 Geology . . . . . 59
3.1.1 Geotechnical . . . . . 60
3.2 Water Resources . . . . . 61
3.2.1 Surface Water . . . . . 61
3.2.2 Groundwater . . . . . 65
3.2.3 Adit Water . . . . . 69
3.3 Soils . . . . . 74
3.4 Wildlife and Fisheries . . . . . 76
3.4.1 Vegetation Types . . . . . 76
3.4.2 Local Wildlife Species of Concern . . . . . 77
3.4.3 Threatened, Endangered, and Sensitive Species . . . . . 79
3.4.4 Fisheries . . . . . 80
3.5 Air Quality and Climate . . . . . 81
3.5.1 Air Quality . . . . . 81
3.5.2 Climatology and Meteorology . . . . . 82
3.6 Land Uses . . . . . 83
3.6.1 Recreation . . . . . 83
3.6.2 Wilderness . . . . . 83
3.6.3 Beartooth Ranch Operation . . . . . 83
3.6.4 Land Uses Outside the National Forest . . . . . 83
3.7 Aesthetics . . . . . 84
3.7.1 Visuals . . . . . 84
3.7.2 Noise . . . . . 85
3.8 Socioeconomics/Traffic . . . . . 85
3.8.1 Population . . . . . 86
3.8.2 Labor Force . . . . . 87
3.8.3 Personal Income . . . . . 89
3.8.4 Structure of the Local Economy . . . . . 90
3.8.5 Housing . . . . . 93
3.8.6 Community Services and Facilities . . . . . 94

3.8.7 Attitudes, Beliefs, and Values . . . . . 96
3.8.8 Property Tax Base . . . . . 97
3.8.9 Mine Access Corridors and Use Patterns . . . . . 98
3.9 Cultural Resources . . . . . 100

CHAPTER 4 - ENVIRONMENTAL CONSEQUENCES . . . . . 101
4.0 Introduction . . . . . 101
4.1 Tailing Impoundment Construction and Operation . . . . . 101
4.1.1 Environmental Consequences of Impounded Tailing . . . . . 103
4.1.2 Geotechnical Issues and Environmental Consequences Common to All Potential Impoundment Actions . . . . . 103
4.1.3 Geotechnical Issues and Environmental Consequences that are Unique to the Tailing Impoundment Alternatives Being Evaluated . . . . . 106
4.1.3a Tailing Impoundment Alternative 3a, No Action . . . . . 107
4.1.3b Tailing Impoundment Alternative 3b, Company Proposal . . . . . 108
4.1.3c Tailing Impoundment Alternative 3c, Partial Approval . . . . . 109
4.1.3d Alternative 3d — Modified Tailing Impoundment . . . . . 110
4.2 Water Resources . . . . . 111
4.2.1 Hydrologic Consequences of the Alternatives Being Considered . . . . . 111
4.2.2 Water Quality . . . . . 114
4.2.2a Alternative 4a - No Action . . . . . 118
4.2.2b Alternative 4b - Company's Proposal . . . . . 122
4.2.2c Alternative 4c — Advanced Treatment . . . . . 130
4.2.3 Alternative 3 — Tailing Impoundments . . . . . 131
4.2.4 Alternative 5 — Company Proposal with Modifications . . . . . 131
4.2.5 Cumulative Impacts . . . . . 132
4.3 Soils and Tailing Impoundment Reclamation/Revegetation . . . . . 132
4.3.1 Soil Salvage Review . . . . . 133
4.3.1.1 Alternative 3a No Action . . . . . 135
4.3.1.2 Alternative 3b Company's Proposal . . . . . 136
4.3.1.3 Alternative 3c Partial Approval . . . . . 136
4.3.1.4 Alternative 3d Modified Impoundment . . . . . 136
4.3.1.5 Proposed Action with Modifications — Alternative 5 . . . . . 137
4.3.2 Cumulative Soil Impacts . . . . . 138
4.4 Wildlife . . . . . 138
4.4.1 Alternative 1 No Action . . . . . 139
4.4.2 Alternative 2 Company's Proposal . . . . . 140
4.4.3 Alternatives 3a Tailing Impoundment No Action and 3c Tailing Impoundment Partial Approval . . . . . 141
4.4.4 Alternative 3d Modified Tailing Impoundment . . . . . 142

4.4.5 Alternatives 4a, b, and c Water Treatment ..... 143
4.4.6 Proposed Action with Modifications — Alternative 5 ..... 144
4.5 Air Quality ..... 145
4.5.1 No Action ..... 145
4.5.2 Company's Proposal ..... 145
4.5.3 All Alternatives ..... 145
4.6 Land Uses ..... 146
4.6.1 No Action ..... 146
4.6.2 Company's Proposal ..... 147
4.6.3 Other Alternatives ..... 147
4.6.4 Recreation ..... 148
4.7 Aesthetics - Introduction ..... 149
4.7.1 No Action ..... 149
4.7.2 Company's Proposal ..... 149
4.7.3 Tailing Impoundment Alternatives ..... 150
4.7.4 Water Treatment Alternatives ..... 150
4.7.5 Mitigated Company's Proposal ..... 150
4.8 Socioeconomics/Traffic ..... 150
4.8.1 No Action ..... 150
4.8.1.1 Socioeconomics ..... 150
4.8.2 Company's Proposal ..... 151
4.8.2.1 Socioeconomics ..... 151
4.8.3 Other Alternatives ..... 156
4.8.4 Traffic ..... 156
4.9 Commitment of Resources ..... 160
4.9.1 Irreversible and Irretrievable Impacts ..... 160
4.9.2 Other Impacts Cannot be Totally Mitigated ..... 160

CHAPTER 5 - COMPARISON OF ALTERNATIVES ..... 163
5.0 Summary and Comparison of Alternatives ..... 163
5.1 Alternative 1 — No-Action ..... 163
5.2 Alternative 2 — Company's Proposal ..... 166
5.3 Alternative 3 — Tailings Impoundment ..... 168
5.4 Alternative 4 - Water Resources ..... 169
5.5 Alternative 5 - Proposed Action with Modifications ..... 170
5.6 Conclusions ..... 172

LIST OF PREPARERS ..... 179

## LIST OF TABLES


Table 2.3-1 Proposed Personnel Requirements by Shift . . . . . 27
Table 2.3-2 Summary of Volume of Soil in Existing Stockpiles . . . . . 35
Table 2.3-3 Water Resources Monitoring Plan — 1990 Operational Monitoring Stillwater Mining Company . . . . . 38
Table 2.3-4 Requested Change in Water Quality Limits (1) . . . . . 40
Table 2.4-1 Tailing Impoundment Alternatives . . . . . 42
Table 2.5-1 Comparison of Conventional and Advanced Water Treatment Options . . . . . 47
Table 3.2-1 Surface Water Quality Data for Stillwater River (SMC-1A, 2 and 10), Nye Creek (SMC-7) and Mountain View Creek (SMC-6) . . . . . 64
Table 3.2-2 Groundwater Quality Data - Selected West Side Monitoring Wells . . . . . 67
Table 3.2-3 Groundwater Quality Data - East Side Monitoring Wells . . . . . 69
Table 3.2-4 Water Quality Stillwater Valley Ranch Monitoring Well . . . . . 70
Table 3.2-5 West Side Adit (SMC-3), East Side Adit (SMC-9) and Tailing Impoundment (SMC-4) Water Quality Data . . . . . 72
Table 3.2-6 Composite Adit Water Quality and Applicable Water Quality Standards . . . . . 73
Table 3.3-1 Soil Mapping Units Rated for Suitability as Source of Topsoil Material . . . . . 75
Table 3.3-2 Soil Replacement Volumes . . . . . 76
Table 3.5-1 Summary of the PM-10 Suspended Particulate Data January, 1990 - December, 1990 . . . . . 81
Table 3.8-1 Labor Force Statistics for Stillwater County . . . . . 89
Table 3.8-2 1989 Personal Income by Major Component . . . . . 90
Table 3.8-3 1989 Labor Income by Major Industry Stillwater County and Montana . . . . . 91
Table 3.8-4 Covered Employment and Wages In Stillwater County, Montana-1989 . . . . . 92
Table 3.8-5 Farm Statistics - 1982 and 1987 . . . . . 93
Table 3.8-6 Enrollment in Stillwater County Schools March 31, 1991 . . . . . 96
Table 3.8-7 Average Daily Traffic: FAS 419, FAS 420, FAP 78 . . . . . 99
Table 3.8-8 Residence Area for Stillwater Mining Company Employees (3/31/91) . . . . . 100
Table 4.2-1 Summary of Effluent Limits in SMC Surface Water Discharge Permit . . . . . 118
Table 4.2-2 Projected Surface Water Quality from Direct Discharge for Alternative 4a . . . . . 119
Table 4.2-3 Projected Groundwater Quality from Discharge to SVR Percolation Ponds for Alternative 4a . . . . . 120
Table 4.2-4 Projected Surface Water Quality Changes from Discharge of Adit Water to SVR Percolation Ponds . . . . . 121
Table 4.2-5 Application Rate in Pounds per Acre at SMC and EPA Recommended Cumulative Limits for Agricultural Croplands . . . . . 122
Table 4.2-6 Projected Surface Water Quality from Direct Discharge Under Instream Values Requested in Petition . . . . . 123
Table 4.2-7 Projected Groundwater Quality from Discharge to SVR Percolation Ponds . . . . . 124

Table 4.2-8 Projected Surface Water Quality from Discharge of Adit Water to SVR Percolation Ponds . . . . . 124
Table 4.2-9 Application Rate in Pounds Per Acre Under Alternative 4b and Percent Increase Relative to No Action . . . . . 125
Table 4.3-1 Alternative 3a. Soil Loss Calculations for a 50 percent (2:1) slope with an embankment height of 141 feet. Final reclamation success assuming 50 percent canopy cover, 50 percent rock fragments on the surface, and total ground cover of 60 percent. . . . . 135
Table 4.5-1 Total Particulate Emissions - Worst-Case Annual Period . . . . . 146
Table 4.8-1. Projected Mine-Related Vehicle Traffic per Day . . . . . 157
Table 5.0-1 Summary of Alternatives . . . . . 164

LIST OF FIGURES


Figure 1.1-1 Project Location . . . . . 2
Figure 2.3-1 Facilities Location Map . . . . . 18
Figure 2.3-2 Stillwater Mining Company Water Balance . . . . . 22
Figure 2.3-3 Conceptual Plan View of Reclaimed Tailing Impoundment . . . . . 29
Figure 2.3-4 Conceptual Reclamation Scheme – Section Through Tailing Impoundment . . . . . 30
Figure 2.3-5 Typical Cross Section, Temporary Waste Rock Storage . . . . . 33
Figure 2.3-6 Typical Cross Section, East Side Waste Rock Storage/Berm . . . . . 34
Figure 3.2-1 Monitoring Site Locations . . . . . 63
Figure 3.8-1 Average Annual Rate of Change in Population . . . . . 87
Figure 3.8-2 1990 Population Distribution, by Race . . . . . 88
Figure 3.8-3 Civilian Unemployment Rates . . . . . 89
Figure 3.8-4 Per Capita Personal Income . . . . . 91
Figure 4.8-1 Employment Impacts of the Proposed Action . . . . . 153

# CHAPTER 1 - INTRODUCTION

## 1.1 Project Location and Background

The Stillwater Mining Company (SMC) (a partnership between Manville Mining Company and Chevron U.S.A., Inc. acting through its agent, The Pittsburg and Midway Coal Mining Company) is operating an underground platinum/palladium mine in Stillwater County, Montana (Figure 1.1-1). The closest community is Nye, Montana, which is approximately 5 miles northeast of the mine site.

Currently SMC has approval to operate the mine with a nominal ore production rate averaging 365,000 tons per year (tpy), or 1,000 tons per day (tpd). The ore is upgraded on site by crushing, grinding, floating, and drying to obtain a dried concentrate. Approximately 75 percent of tailing created during the milling process is returned underground for use as backfill in mined out stopes. The remaining 33 percent is disposed of in a lined tailing impoundment adjacent to the mine and mill facility. The dried concentrate is shipped by truck to a smelter located in Columbus, Montana, for further processing to the matte stage. The smelter matte is subsequently shipped to Belgium for refining.

SMC's original plan of operations and permit were approved after distribution of a Final Environmental Impact Statement and Record of Decision, jointly written by the Department of State Lands and the Custer National Forest (DSL/FS, 1985). The current proposal, if approved, would be the eighth amendment to the original plan of operation and permit. The following is a summary of all previously approved amendments.

Amendment 001 was approved and permitted June 30, 1986. This amendment relocated mine and mill facilities.

Amendment 002 was approved and permitted September 8, 1986. This amendment allowed excavation of a sand borrow area.

Amendment 003 was approved and permitted January 8, 1987. This amendment allowed excavation of a second sand borrow area.

Amendment 004 was approved and permitted February 24, 1987. This amendment relocated the southern portion of the tailing impoundment toe dike.

Amendment 005 was approved and permitted March 2, 1989. This amendment was the first major amendment since the original permit. It increased the permitted acreage to 1,158 and permitted mining on the east side of the Stillwater River.

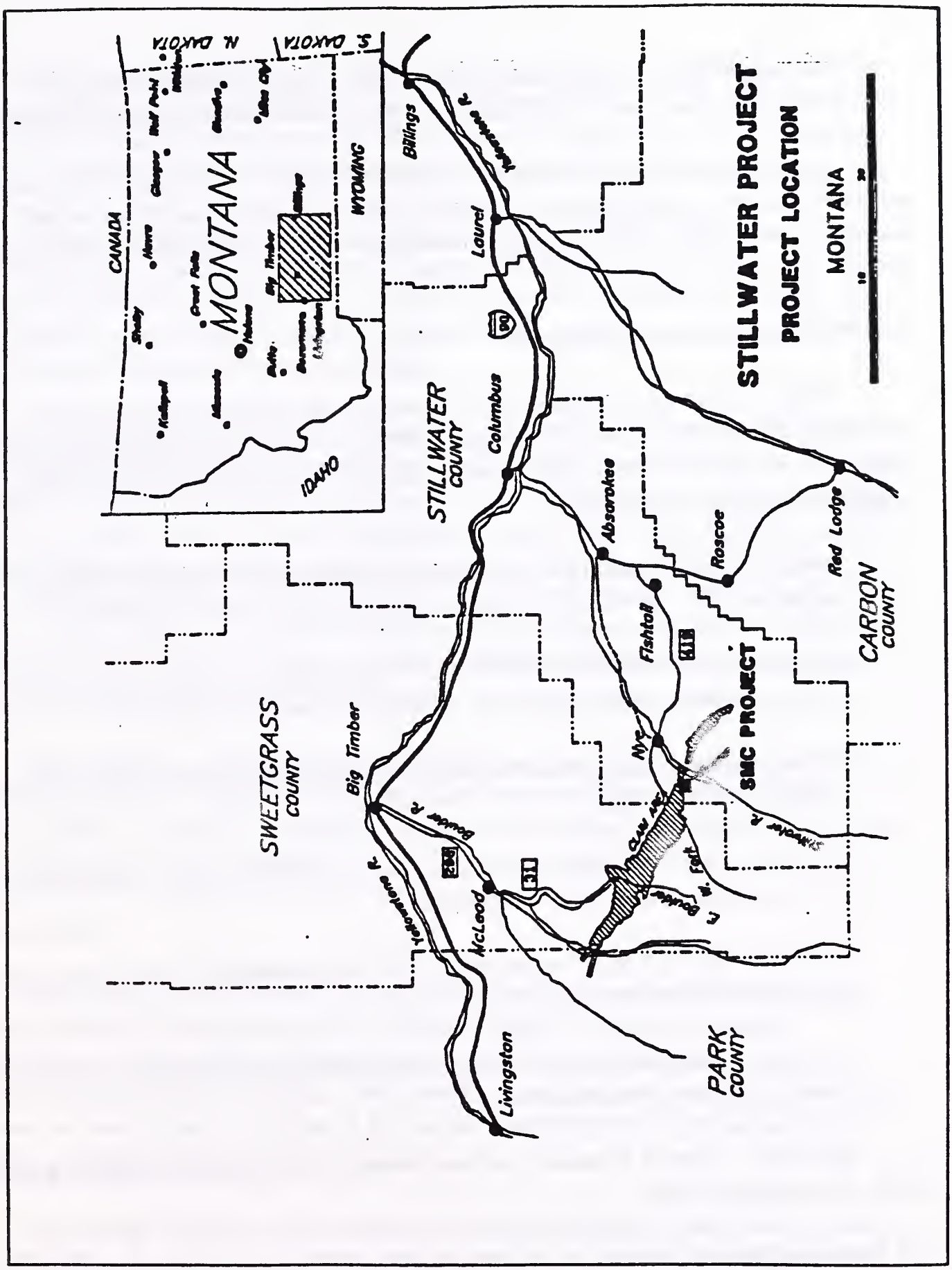



Figure 1.1-1 Stillwater Project Location

Amendment 006 was approved and permitted July 21, 1989. This amendment was for construction of a temporary sand slurry pipeline connecting the east and west sides of the mine area.

Amendment 007 was approved and permitted November 15, 1990. This amendment was for construction of three percolation ponds and monitoring wells. The environmental analyses and decision documents of all previous amendments are incorporated by reference into this environmental analysis.

## 1.2 Brief Summary of the Proposed Action

SMC has submitted an amendment to the current plan of operations which proposes to increase the mine production rate to 730,000 tpy (2,000 tpd), with the anticipated production period remaining at about 18-20 years. In order to achieve this goal SMC has proposed the following changes to their plan of operations.

Enlargement of the existing tailing impoundment capacity to allow disposal of additional tailing slimes for a period of 18-20 years at the new production rate of 730,000 tpy.

Disturbance of an additional 35 acres within the current permit boundary for uses such as waste rock storage, mining storage, new building and visual berm construction.

Expansion of the milling system, tailing disposal system, sewage treatment system, and employee vehicle parking lot.

Relocation of the mill complex main entrance, security building, and mine equipment/truck shop, warehouse, and mill maintenance shop.

Incremental addition from the current level of 364 (460 permitted) full-time employees up to an ultimate employment of 525 persons.

A petition to change ambient water quality for total dissolved solids, ammonia, nitrates and metals in both surface and groundwater.

Please refer to Chapter 2, section 2.3 of this document and the application regarding specific details of the proposed action.

## 1.3 Purpose and Need for Action

SMC has submitted a proposal to amend its plan of operations in accordance with Federal and State regulations. The General Mining Law of 1872 grants all U.S. citizens the right to explore,

develop, and produce mineral resources on federal lands open to mineral entry. SMC operates the only economically viable platinum/palladium mine in the western hemisphere. The Stillwater Mine accounts for five percent of world production. To better compete against Soviet Union and South African sources, SMC wishes to increase production, thereby lowering its unit costs.

This document has been jointly prepared by the Custer National Forest (CNF) and the Montana Department of State Lands (DSL) in cooperation with the Department of Health and Environmental Sciences (DHES) in response to the plan of operations amendment proposed by SMC. The document has been prepared in compliance with the Montana Environmental Policy Act (MEPA) and the National Environmental Policy Act (NEPA).

The purpose of this Environmental Assessment (EA) is to disclose the environmental effects of potential agencies' decisions regarding SMC's proposed mine plan amendment, and alternatives to the proposed amendment, and to determine whether or not an environmental impact statement (EIS) is necessary. In addition, this EA will evaluate effects of potential Board of Health and Environmental Sciences (BHES) decisions regarding the affect of the mine plan on water quality. The Decision Notice will outline the decision to implement specific actions affecting the plan of operations and state permit. Although effects of other potential activities within the Stillwater Complex are included in this analysis, the Forest Service's decision document resulting from this environmental analysis will make a decision only on the proposed expansion.

The Commissioner of State Lands and the Forest Supervisor of the Custer National Forest are the officials responsible for approving SMC's proposal to expand their existing operation in the Stillwater Complex. The BHES is responsible for approving any change in ambient water quality that may result from the proposed expansion.

## 1.4 Land Status

The proposed mine development is located along the east and west banks of the Stillwater River approximately 5 miles southwest of Nye, Montana, (Figure 1.1-1) and encompasses approximately 1,233 acres within the permit boundary. Land ownership in the permit area is composed of federal and private holdings. SMC privately owns 332 acres in the existing permit area, 775 acres are owned by the United States of America and managed by the U.S. Forest Service, and 126 acres are privately owned by the Mouat Estate.

SMC through Manville has made application to patent 173 additional acres within the current permit boundary. The application is currently being reviewed by the the U.S. Forest Service in cooperation with the U.S. Bureau of Land Management.

## 1.5 Agency Roles and Responsibilities

On December 11, 1989, the State of Montana, Department of State Lands and the U.S. Department of Agriculture, Forest Service entered into a Memorandum of Understanding (MOU) to promote efficiency and effectiveness in their administration and regulation of locatable mineral activities under their respective authorities and responsibilities. This MOU provided for the preparation of joint environmental analyses, sharing of information, personnel, and funds. It is the policy of both agencies to prepare such environmental analyses that will meet the requirements of both National Environmental Policy Act (NEPA) and Montana Environmental Policy Act (MEPA) and other applicable State and Federal laws and regulations.

### 1.5.1 Department of State Lands

The Commissioner of State Lands must decide whether to approve the project as applied for, approve alternative plans, approve subject to modification through stipulations, or deny the permit as required by the Montana Metal Mine Reclamation Act (MMRA)(Title 82, Chapter 4, Part 3, MCA).

The DSL administers the MMRA which applies to all state, federal and private lands. The purpose of the act is to provide that the usefulness, productivity, and scenic values of all lands and surface waters involved in mining and exploration receive the greatest reasonable degree of protection and are reclamed to beneficial use. The act and its regulations (ARM 26.4.101 et seq.) set forth the steps to be taken in the issuance of an operating permit for and the reclamation of the applicant's proposed mine expansion. The act applies to private, federal and state lands within Montana.

DSL's rules (ARM 26.2.601 et seq.) implementing MEPA (Title 75, Chapter 1, MCA) also require preparation of an environmental analysis. The Department has determined that an Environmental Assessment (EA) is appropriate for this project. This EA has several purposes:

a. It serves to ensure that the agency uses the natural and social sciences and the environmental design arts in planning and decision-making;

b. It assists in the evaluation of reasonable alternatives and the development of conditions, stipulations or modifications to be made part of a proposed action;

c. It determines the need to prepare an EIS through an initial evaluation and determination of the significance of impacts associated with a proposed action;

d. It ensures the fullest appropriate opportunity for public review and comment on proposed actions, including alternatives and planned mitigation, where the residual impacts do not warrant an EIS; and

e. It examines and documents the effects of a proposed action on the quality of the human environment, and provides the basis for public review and comment.

The Commissioner may deny a permit when it can be demonstrated that air and water statutes cannot be complied with and/or the reclamation plan as proposed is not feasible (82-4-351, MCA). A permit may also be denied if a person, or any firm or business association of which that person was a principal or controlling member has a bond forfeited (82-4-360, MCA) or for failure to reclaim an operation (82-4-341(6), MCA). SMC has not forfeited any bonds under the MMRA and has not failed in its reclamation obligations.

Reclamation bonding is also determined by DSL under MMRA. Reclamation bonds are determined by computing costs to the State of reclaiming a site should the operator default. After an application has been approved and mitigation measures are stipulated, the bond is calculated based on the approved and permitted specifications. The bond will include long-term maintenance of water treatment facilities such as percolation ponds and diversion ditches, demolition of buildings, and other facilities, earth movement and soil replacement, seedbed preparation and revegetation.

In addition, if the Forest Service should deem the State's bond insufficient, the Forest Service could require its own bond. SMC's present bond is $1,477,000.00.

### 1.5.2 U.S. Forest Service

The Forest Service has authority for regulating all activities and uses of National Forest system lands. The Forest Supervisor can decide to approve the amendment to the mine plan of operations as submitted, approve the amendment to the mine plan with modifications or mitigation measures, or notify SMC that the amendment can not be approved until an environmental impact statement has been prepared (36 CFR 228).

The 1872 General Mining Law, as amended, grants all US citizens the right to locate and develop a mining claim on national forest system lands open to mineral entry. At the same time, the Organic Administration Act of 1897 authorizes the Secretary of Agriculture to regulate occupancy and use of the national forest resources. The regulations (36 CFR 228) pertain to all National Forest users who operate under the mining laws. The Forest Service retains the right to manage and dispose of surface resources on unpatented mining claims to the extent that this does not unreasonably interfere with mining activity.

The U.S. Forest Service management policy for mining activity originates from the 1872 General Mining Law, as amended, the Mining and Mineral Policy Act of 1970, the National Materials and Minerals Policy, Research and Development Act of 1980, and a number of executive

orders. It is National Forest Service policy to encourage the exploration, development, and production of mineral resources on all lands open to mineral entry.

The area involved in this proposal is within Management Area E as described in the Custer National Forest Land and Resource Management Plan (1986). The management goal for Management Area E is as follows:

> To facilitate and encourage the exploration, development, and production of energy and mineral resources from the National Forest System lands. Other resources will be considered and impacts will be mitigated to the extent possible through standard operating procedures, and, on a limited basis, through special lease stipulations necessary to manage key surface resources. Energy/mineral development will not be precluded by these resource concerns within legal constraints. Efforts will be made to avoid or mitigate resource conflicts. If the responsible official determines that conflicts cannot be adequately mitigated she/he will resolve the conflict in accordance with the management goal and, if necessary, in consultation with affected parties. (Forest Plan, page 58).

### 1.5.3 Other Federal Agencies

#### U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service (USFWS) administers the Endangered Species Act (ESA) and the Bald Eagle Protection Act. To comply with the ESA the CNF must prepare a Biological Assessment to determine impacts, if any, which would adversely affect threatened and endangered species. If it is determined adverse effects may occur, the CNF would consult with the USFWS to design measures to protect the affected species.

### 1.5.4 Other State Agencies

#### Department of Health and Environmental Sciences, Air Quality Bureau

The Air Quality Bureau of DHES administers the Clean Air Act of Montana (Title 75, Chapter 2 MCA). Any proposed project with potential to emit more than 25 tpy of any pollutant must obtain an air quality permit prior to construction. The applicant must apply Best Available Control Technology to each emission source. The applicant must also demonstrate that the project will not violate Montana or Federal Ambient Air Quality Standards. SMC already has an Air Quality Permit, No. 2-459A for its current operations. A permit alteration is being reviewed relative to this proposal.

Department of Health and Environmental Sciences, Water Quality Bureau

The Water Quality Bureau (WQB) is responsible for administration of several state statutes including the Public Water Supply Act (Title 75, Chapter 6 MCA), Sanitation and Subdivisions Act (Title 76, Chapter 4 MCA) and the Water Quality Act (Title 75, Chapter 5 MCA). The Board of Health and Environmental Sciences (BHES) is the policy making body which oversees and approves actions of the Department. The WQB also administers several sections of the federal Clean Water Act pursuant to the Montana - Environmental Protection Agency (EPA) Agreement. The State of Montana, through the WQB, has been delegated authority for administration of the Nonpoint Source Pollution program (319), National Pollution Discharge Elimination System (NPDES), and Water Quality Standards (CWA section 307).

The Water Quality Act (WQA) provides a regulatory framework for protecting, maintaining and improving the quality of water for beneficial uses. Pursuant to the WQA, the WQB has developed water quality classifications and standards, and a permit system to control discharges into state water. Mining operations must comply with Montana surface and groundwater regulations and standards. SMC currently holds a Montana Pollution Discharge Elimination System (MPDES) permit (MT-0024716) for discharge of excess adit water into the Stillwater River. This permit expired on March 31, 1991 but has been extended by the WQB pending action by the BHES on SMC's nondegradation petition.

During the agencies' review of SMC's Amended Plan of Operations, the WQB determined that the expansion would constitute an enlarged source of pollution and, therefore, would be subject to Montana's nondegradation rules (ARM 16.20.701 et seq.). Subsequently, SMC submitted a Petition for Modification of Quality of Ambient Water (SMC, 1991a) to the BHES on August 19, 1991. The WQB determined the application complete on August 20, 1991, and the BHES decided at its August 23 meeting to participate in the ongoing USFS-DSL Environmental Assessment (EA).

This EA includes an analysis of the petition. Following preparation of the Final EA the WQB will prepare a report and recommendations to the BHES. The BHES will hold a formal public hearing on the petition at a meeting February 21, 1992. A decision to grant, or deny the petition can either be made at that time, or, not later than the BHES's next regularly scheduled meeting. All persons who are on the DSL EA mailing list will receive notice of BHES's hearing.

The BHES may allow degradation of state water based on necessary economic or social development but in no case may degradation be allowed that will preclude any present or future beneficial use. Following BHES action a statement of reasons for granting or denying the petition will be issued.

Department of Commerce, Hard Rock Mining Impact Board

The Hard Rock Mining Impact Board, created by the passage of the Hard Rock Impact Act (Title 90, Chapter 6, Part 3, MCA) is attached to the Montana Department of Commerce for administrative purposes. A quasi-judicial board, it is intended to act as a referee in hearing disputes between local government and large-scale mineral developers over the impact mitigation plan. The impact mitigation plan identifies the increased public-sector costs associated with the mineral development and commits to pay, according to a specified time schedule, all increased capital and net operating cost to local government resulting from development. Projected workforce of 525 is 65 higher than the presently approved 460 employees. Therefore, development of the 2000 tpd proposal will not trigger the Hard Rock Impact Act because the projected employment levels are within the accepted variance (15 percent) of the Plan currently in place (SMC, Stillwater County, 1988).

State Historic Preservation Office (SHPO)

The SHPO has the responsibility of cooperating with and advising DSL and the FS when potentially valuable historical, archeological, or other cultural resources are located within a project area (Montana Antiquities Act MCA 22-3-401 through 22-3-442 and the National Historical Preservation Act PL 89-665 as amended and reauthorized E.O. 11593). Advice given may include comments on an applicant's plan for impact mitigation of sites eligible for nomination to the National Register of Historic Places. The office also reviews the environmental document to ensure compliance with cultural resource regulations. During mine operation, DSL and FS are responsible for monitoring compliance with cultural resource laws and monitoring plans.

Department of Natural Resources and Conservation (DNRC)

DNRC administers two acts that are applicable to mining development. These are The Montana Major Facility Siting Act (Title 75, Chapter 2, MCA) and the Montana Water Use Act (Title 85, Chapter 2 MCA). Any electrical transmission line that exceeds 69 kV or 10 miles in length requires state approval. A water rights permit is required for any surface water diversion or groundwater withdrawal exceeding 35 gallons per minute or 10 acre feet per year. No new power lines were proposed; no additional water rights need to be implemented.

## 1.6 The NEPA/MEPA Process

The National Environmental Policy Act (NEPA) and the Montana Environmental Policy Act (MEPA) are Federal and State laws which direct the Forest Service, the DSL and DHES to disclose effects of proposed activities on Federal and State lands to the public and officials making decisions concerning the proposal.

The NEPA/MEPA process began when SMC proposed to amend its current mining plan of operations. The agencies sought public input to help identify environmental issues and concerns through the process called "scoping." Scoping activities for this project included: mailing a scoping document to interested persons; receipt of questionaire responses and letters; and holding a public meeting in Absarokee, Montana, June 4, 1991. Numerous newspaper articles were published in the local Stillwater and Carbon County papers.

In addition to public scoping the agencies reviewed the proposal for "completeness" to ensure adequate information was contained in the proposal to complete the agencies' environmental analysis. During this phase of scoping the Water Quality Bureau determined that SMC's proposed actions constituted a new and enlarged discharge source and were subject to nondegradation standards. SMC then submitted a petition to amend ambient standards. The environmental analysis phase of the NEPA/MEPA process began after the proposal was declared "complete".

Issues and alternatives are developed based on public input gathered during scoping. These issues are then tracked through the environmental analysis phase of the document.

The deciding officials review the alternatives and weigh the opportunities, tradeoffs, positive and negative impacts, and come to a decision. The decision document outlines the major points of the decision and the rationale used to reach the decision. The activities outlined in the decision document are then approved to be implemented on the ground. All Forest Service decisions can be appealed under Federal appeal regulations.

## 1.7 Issues and Concerns

This section of the document discloses environmental and social concerns raised during the scoping process. Some concerns fall outside the scope of analysis, such as length of the permitting process and drug education. Other concerns were related to specifics of the application and its possible effects. These concerns were identified by the agencies and were collated into the following list:

1. Tailing Impoundment Stability/Engineering - There were concerns about the ability of the structure to resist failure from its own weight and by the increased stresses from earthquakes. Steepening the slope from 2h:1v to 1.6h:1v means stability must be reevaluated because catastrophic failure would affect surrounding terrestrial and aquatic ecosystems and might be a threat to human safety.

2. Tailing Impoundment Reclamation/Revegetation - Concerns were raised about the existing tailing embankment reclamation plan as well as the proposed plan. Existing plan concerns dealt with long term soil erosion effects on tailing embankment

revegetation success because of the long length of the 2h:1v slopes. The proposed plan concerns questioned what effects rock armored 1.6h:1v slopes would have on visual quality and potential forage for wildlife.

Concerns were also raised about the tailing impoundment surface reclamation plan. The proposed plan would increase the height of the embankment and the depth of tailing. This would complicate reclamation, particularly in view of the limited amount of salvaged soil and available waste rock for capping the impoundment surface.

3. Aesthetics - Aesthetics of the tailing impoundment, mill and mining were of concern. Evaluate visual impact of rock armorment vs vegetation. Identify an area of influence and key viewing points. Evaluate positive visual impacts resulting from SMC's operation. Previous operations left chrome stockpiles, trash, an old mill site and paved lot. Would increased production result in increased noise?

4. Socio-Economics - Increased revenues to the county from mine taxes were supposed to provide relief from increasing property taxes for area residents. Property taxes have increased. Is the mine responsible directly or indirectly for these increases? Evaluate the expansion's impact on local property taxes and the county's tax base. Evaluate the county's ability to provide services with the proposed expansion. Likewise, evaluate impact to area residents if the expansion is not permitted. Increased employment levels at the mine should be addressed in the Hard Rock Impact Plan even though employment may stay below a 15-percent increase.

   Increased traffic might mean greater impact to residents along the access routes. Employees may have a right to drive these roads. Legality of the mitigation requiring 3 passengers per vehicle is in question. This should be resolved. Safety needs to be increased before FAS 419 is resurfaced.

5. Wildlife - Concerns were raised about impacts to fish and wildlife due to impoundment construction, mine waste water discharge, or increased sewage disposal. Is wildlife displacement expected? Elimination of the toe dike area of grass may impact the local bighorn sheep herd. Mitigation measures related to bighorn sheep have been in place since mining operation started. It seems the sheep population has not benefitted. Why continue these measures? It appears adverse impacts to wildlife have not occurred due to mining in the area. Evaluate all the sources of bighorn mortality such as mountain lions, eagles, diseases, and mining.

6. Water Resources - Concerns were that the proposal may make changes in water quality and quantity for groundwater and surface water, and the changes may not comply with Montana's nondegradation law.

7. Wetlands/Flood Plain - The possible loss of wetlands was of concern.

8. Cumulative Effects/Greater Yellowstone Area - Concern was expressed concerning the cumulative impacts to the Greater Yellowstone Area.

9. Soil Salvage - Concerns were raised about soil salvage to date and the effect on reclamation feasibility for all SMC disturbances.

## 1.8 Issue Statements

Issue statements briefly summarize portions of the proposal, and then link those portions to the substantive issues raised during scoping. Issue statements focus and help define the range of the analysis.

### 1.8.1 Tailing Impoundment

SMC proposes to amend the current plans for construction and reclamation of the tailing impoundment. These modifications are designed to increase the storage capacity required to accommodate doubling ore production and increase the life of the tailing impoundment. Specific modifications include 1) increasing the height of the impoundment, 2) steepening the impoundment side slopes, and 3) covering impoundment side slopes with large rocks. The increased depth of the tailing would increase the potential settlement of tailing mass. Presently, the tailing impoundment elevation is approved at elevation 5,111 feet during final reclamation. SMC proposes to increase the final reclamation elevation to 5,128 feet.

In accordance with current stipulations, all tailing impoundment side slopes have been constructed at a 2h:1v slope. The submitted amendment proposes to increase the exterior slope steepness to 1.6h:1v, thereby increasing the storage capacity of the tailing facility. The current final reclamation plan calls for 100 percent vegetative cover on impoundment slopes. Increasing slope steepness may make the establishment of vegetation difficult during final reclamation. SMC proposes to replace final reclamation vegetation with the placement of large rocks on the slope surface.

These changes may result in varying degrees of impacts to area resources. Recreationists and local residents may be aesthetically impacted due to an increase in tailing impoundment height, increased steepness of impoundment slopes, replacement of vegetation with large rocks at the final reclamation stage, the creation of additional noise, and fugitive dust during construction of mining

support facilities. These impacts would be most noticeable during the peak visitor use period which occurs between June 1 and September 15 annually. However, some degree of impacts would occur throughout the year, mainly to people residing in the project area.

Increased impoundment height in conjunction with increased slope steepness may render the impoundment facility more susceptible to failure from both internal and external forces by reducing the factor of safety to minimum engineering standards. The tailing impoundment lies in a region that is still geologically active as evidenced by earthquakes and fault movement in the area. A failure of the tailing impoundment also could have serious consequences for the Stillwater River and those creatures which utilize the river. Presently, the Stillwater River provides quality spawning habitat for trout species. The addition of tailing slimes to these spawning areas could impact the existing coldwater fisheries.

Increased impoundment height could slow down the reclamation process and increase the likelihood that final reclamation gradients could not be maintained. Limited waste rock and soil are available for capping the tailing.

The amount of soil salvaged to date, soil losses from erosion and potential soil losses from piping into subsurface embankment construction materials on the currently permitted vegetated 2h:1v tailing embankment face make reclamation success questionable.

Rock armor on a 1.6h:1v proposed embankment face limits soil use and subsequent soil loss, but has potential visual impacts as well as eliminating potential forage for wildlife.

Large pre-existing disturbances and boulders on the surface of undisturbed soils have limited soil salvage to date. Increased awareness of the value of marginal soils for reclamation have changed the agencies' soil salvage standards since the SMC operating permit was issued in 1985. The agencies believe that the presently approved reclamation plan for all mine disturbances should be reevaluated to address "comparable stability and utility" as required by the Metal Mine Reclamation Act and SMC's long-term reclamation objective of "re-establishment of post-operational biological potential suitable for supporting vegetation cover and wildlife habitat appropriate to the area".

### 1.8.2 Socio-Economics/Traffic

Presently SMC employs approximately 364 persons at the mine site south of Nye, Montana. Under the proposed amendment, the level of employment would be incrementally increased to 525 full-time employees. The majority of SMC personnel live either in Stillwater or Carbon counties. These people reach the mine site via major county roads.

As employment levels at the mine increase, the projected volume of commuter traffic will likewise increase. County residents who live along access routes may have their quality of life effected by this traffic. The safety of local residents along these access routes and within small towns has been identified as a concern.

Increased population levels may place pressures on the abilities of Stillwater and Carbon counties to supply goods and services to all county residents. Real property values of persons living in the Stillwater Valley could be effected by expansion of the mine complex. Additionally, capital investments required for increased production might directly influence incoming revenues to Stillwater County.

Increased mine activity in the vicinity of Woodbine campground, trailhead, and the Horseman Flats area may influence recreational use patterns.

### 1.8.3 Wildlife

The area around the Stillwater mine currently provides critical winter range for bighorn sheep. Recently the herd has experienced major population declines. Additional impacts to this herd may take place due to an increase in mine-related traffic or the proposed tailing impoundment modifications. These tailing facility modifications would eliminate current forage or future forage from use by the bighorn sheep herd.

Elk have historically used the grass/forb vegetation communities which lie in the vicinity of the mine complex. Concern has been raised related to the effects of increased mining to this species.

### 1.8.4 Surface and Groundwater Resources

Doubling production at the mine would not require approval of new adit development. However, adits which have been approved would be used for access to increased ore production. This would require additional underground blasting in order to free the ore which will be removed for milling.

As a result of this underground blasting, aquifers may be altered in terms of flow patterns or chemical composition. If these bedrock aquifers are altered, springs or creeks may dry up or be rendered unusable for human or wildlife use. The greatest impact would take place during the time of year when surface flows are typically low (September to April).

### 1.8.5 Wetlands/Flood Plains

Currently, the tailings impoundment facility does not encroach upon the Stillwater River 100-year flood plain. Modifications to the tailing facility's engineering design may effect either the flood plain or any associated wetlands in the area by extending the toe slope towards the Stillwater River. This could potentially eliminate habitat for wildlife species which depend on wetlands or flood plain vegetation communities.

# CHAPTER 2 - SUMMARY OF PROPOSALS, ALTERNATIVES, AND OTHER DEVELOPMENTS

## 2.0 Introduction

This chapter summarizes the proposed action submitted by SMC and alternatives to the proposed action, including a no-action alternative (Alternative 1). The first subsection of this chapter, Development of Alternatives (2.1), describes how the alternatives analyzed in this environmental assessment were developed. The next subsection (2.2), describes the no-action alternative (Alternative 1) whereby the permit for increased production would not be approved. The no-action alternative would represent the continuation of current mining activity at the Nye facility. Subsection 2.3 briefly summarizes the proposed action (Alternative 2) as submitted by SMC. The reader is encouraged to read the application for complete information. Modifications to the proposed action which are presented in subsection 2.4 explore changes in the tailing impoundment (Alternative 3a, b, c and d) and mine water treatments (Alternative 4a, b, and c). Mitigation measures developed to minimize or alleviate environmental or socio-economic impacts due to implementation of the proposed action are described in subsection 2.5 (Alternative 5). Finally, subsection 2.6 describes other potential development activities which are reasonably foreseeable on the CNF or the GNF within the project area.

## 2.1 Development of Alternatives

Consideration and evaluation of a full range of alternatives is required by both the MEPA and the NEPA. The reason for this policy is that identification of alternatives may minimize or even eliminate these impacts of the proposed action. In addition, Montana's nondegradation rules require a petition to be submitted to the BHES for amendment of ambient (existing) water quality. The petition must contain alternatives to the proposed effluent levels which would result in no, or less, degradation, of state water [ARM 16.20.704 (3)(e)]. SMC has considered three treatment alternatives in fulfillment of this requirement (SMC, 1991a). Those alternatives are presented and analyzed in this document.

Alternatives have been identified and refined by three basic methods. First, the interdisciplinary team comprised of DSL, WQB and FS resource specialists internally identified alternatives to the proposed action. This tentative list of alternatives appeared on page 2 of the scoping document. The scoping document was mailed to groups or individuals which had previously expressed interest in similar projects.

Second, DSL and the FS held a public meeting in Absarokee, Montana, on June 4, 1991. This step initiated the "scoping" effort for the project. The intent of this meeting was to solicit input in order to develop additional alternatives and to ensure that public issues and concerns were

identified. Project scoping suggested that concerns related to the proposed action focused on possible modifications to the tailing impoundment and water quality and quantity.

Finally, the interdisciplinary team reviewed the tentatively identified alternatives in light of public concern expressed during the scoping period. This exercise has resulted in the final range of alternatives which will be evaluated in this EA.

## 2.2 Alternative 1 - No Action

The no-action alternative is evaluated in order to establish a baseline condition of existing and future environmental conditions in and around the project area as required by the Council on Environmental Quality (CEQ) guidelines. Under this alternative, SMC would not receive a permit to increase ore production to 2,000 tpd. Mining would continue at the current rate of 1,000 tpd, and all existing support facilities, personnel requirements and reclamation stipulations would continue unchanged. Specific details related to the current level of ore production may be found within the 1989 EA/PER for the East Side Amendment. This baseline condition is described in Chapter 3 (Affected Environment).

Under this alternative no "new or enlarged source of pollution" would exist and the nondegradation rules would not apply to SMC operations. The MPDES permit would be renewed with the existing discharge effluent limits, and the current practice of land application would be maintained. Under the existing MPDES permit SMC has been granted a mixing zone for groundwater within the property boundary. Under groundwater rules, standards may be exceeded in mixing zones (ARM 16.20.1010).

## 2.3 Alternative 2 - Company's Proposal

The following description of the proposed action is largely based on SMC's application to amend the approved plan of operations, Permit No. 00118. Additional information has been added where clarification is needed; however, the following summary is quite succinct compared to the level of detail contained in the proposed application. Figure 2.3-1 is a map of the proposed facilities. For the complete project description as proposed by SMC, the reader is referred to the application for Amendment to Permit No. 00118 (SMC, December 1990), called the Mine Expansion - 2,000-tpd application. This application is available for public review at Beartooth Ranger District, Supervisor's Office of the Custer National Forest, and Department of State Lands' Helena office.

### 2.3.1 Mining Plans and Methods

The principal mining method, cut-and-fill stoping, utilized for this amendment would be the same as currently used at the Stillwater Mine. A detailed description of this technique may be found

Figure 2.3-1 Facilities Location Map

in the 1985 Environmental Impact Statement (EIS) for the Stillwater Project on pages II-6 to II-11 (DSL/FS, 1985). SMC's current permit provides for eleven adits and one shaft on the west side of the Stillwater River, and six adits and one shaft on the east side. These openings would be used in developing the ore body, and would be constructed as development occurs over the life of the operation. No additional surface openings are proposed as part of this amendment.

Ore grade is variable throughout the ore zone, which requires that the zone be mined selectively rather than continuously. The ore body is accessed by a crosscut, a raise is driven up into the ore body for stoping. This raise contains an orechute, a manway for personnel access, and a timberslide compartment for materials and supplies transportation. Stopes extend between levels (approximately 200 feet in height), and average approximately 200 feet in length. The stopes are mined from the bottom to the top, taking a series of approximately 8-foot high horizontal cuts. An orechute transfers ore from the stope to the main haulage level below. After each cut is mined, the resultant opening is filled with classified mill tailings or ground and sized sandfill. The sandfill is used to provide a working surface from which the next cut would be mined. A more detailed discussion of mining methods currently used at SMC is contained in the 1988 East Side Expansion Amendment (DSL/USFS, 1988). Use of other mining techniques, such as shrinkage stoping and modified sublevel stoping, may be employed in the future in the areas of the mine where conditions permit.

### 2.3.2 Explosives

Blasting is conducted as an integral part of the mining operations. The types of explosive presently being used are low-solubility, water gel and emulsified explosives.

### 2.3.3 Production

The SMC operation consists of an underground platinum/palladium mine with a nominal production rate averaging 365,000 tpy, or 1,000 tpd of ore. The current amendment proposes to double ore production in order to reach a nominal production rate of 730,000 tpy or 2,000 tpd. This proposed amendment is based upon an operational mine life of 18 to 20 years. The actual life of the operation, however, would be determined by the economical viability of the operation. Project viability is a function of metal prices, ore grade, continuity of the ore zone, and cost of production.

### 2.3.4 Ore Processing

The ore is upgraded on site in the mill by crushing, grinding, flotation, and drying to obtain a dried concentrate. This concentrate is shipped by truck from the Nye operation to SMC's smelter in Columbus, Montana, for further processing to a matte stage. The smelter matte is subsequently shipped to Belgium for refining. Expansion of the mill grinding, flotation, and tailing disposal

RANGE 15 EAST

TOWNSHIP 5 SOUTH

510,000 N

508,000 N

506,000 N

504,000 N

1,896,000 E

1,898,000 E

1,900,000 E

1,902,000 E

1,904,000 E

1,906,000 E

1,908,000 E

Operating Permit Boundary

6900 Portal (Uncanstructed)

Mountain View Townsite

Mountain View Lake

6500 Portal

6300 Portal (Uncanstructed)

6100 Portal (Uncanstructed)

5900 Portal

5900 Laydawn Area/Waste Dump

Proposed Laydawn Area

5700 Portal

5500 Portal

5300 Portal

Topsail Stackpile

Proposed Permanent Waste Rock Storage/ Laydawn Area

Soil Stackpile A

Proposed Drainfield Extension

Proposed Parking Lot Extension

Proposed Temporary Waste Rock Storage

MPC Substation

Proposed Mill Building Extension

5000 Portal (2 Adits)

Proposed Conveyor Stocker

5150 Portal

Mill Building

Laydown Area

Runoff Diversion Berm

Ore Dump Packet

Relocated Warehouse/ Truckshop

Mine Water Emergency Overflow Pond

West Emergency Spill Basin

Thickener

Temporary Waste Rock Storage /Laydawn Area

Soil Stackpile C

Sed/Perc Ponds (3)

Care Storage

Administration Building

Patable Well

Upwind Air Quality Station

Pumphouse

Soil Stackpile B

Relocated Guard Shack

Downwind Air Quality Station

East Emergency Spill Basin

Proposed Permanent Waste Rock Berm For Visual Screening

Proposed Laydown Area

Thickener

Ore Dump Packet

5000 Portal

Proposed Drainfield

Sed/Perc Ponds (5)

Proposed Building

Proposed Parking

Patable Well

5200 Portal (Uncanstructed)

5400 Portal (Uncanstructed)

Topsail Stackpiles

Topsail Stackpile

Percolation Ponds (4)

Currently Permitted (Not Constructed) E. Side Shaft Site

5600 Portal (Uncanstructed)

Surface Vent Raise

5800 Portal (Uncanstructed)

6000 Portal (Uncanstructed)

Legend

- Relocated Facilities
- Proposed New Facilities
- Existing
- Currently Permitted, But Not Constructed Portals
- Existing Roads
- Permitted/Not Constructed Access Roads
- Above Ground Pipelines
- Powerline Corridor

SCALE IN FEET

0 500 1000

Stillwater Mining Company

Facilities Location Map

Existing and Proposed Facilities for Amendment #8

5/8/91

**Figure 2.3-1**

systems are proposed via this amendment. The additional equipment required to support a production rate of 2,000 tpd would be installed within the present mill building in the area directly adjacent to existing ore processing circuit.

Additional details related to ore processing may be found in the 1985 EIS and within Operating Permit No. 00118.

### 2.3.5 Tailing Disposal Facility - Impoundment

SMC proposes to modify the current tailing impoundment specifications. Presently, Operating Permit No. 00118 stipulates that the tailing impoundment embankment slopes will be constructed at a 2h:1v. The storage volume of the impoundment would be increased by changing the slope of the downstream embankment from 2h:1v to 1.6h:1v. The inside slope would remain at 2h:1v. At the proposed increased capacity, the tailing pond surface area would be approximately 52 acres, tailing storage would be approximately 5.0 million tons, and maximum dam height would be approximately 155 feet above ground-level topography. An additional 15 feet would be added to the currently permitted dam height with a 3-foot berm constructed on the crest, for freeboard purposes. The final elevation of the dam would be 5,125 feet plus 3-foot freeboard. Currently, the approved final tailing impoundment elevation is 5,111 feet.

### 2.3.6 Waste Rock

Waste rock is hauled by rail or mobile haulage equipment and dumped into waste/ore passes that extend from the upper levels of the mine to the main haulage levels. This material is then transported out of the mine by rail haulage-systems or rubber-tired trucks where rail systems have not been installed. West-side waste rock is trucked to the tailing impoundment or other locations as needed. Most east-side waste is hauled to the west side for incorporation into the tailing impoundment facility. In addition to the use of waste rock material for construction of the tailing facility, this material may be utilized for 1) road surfacing material, 2) portal yard construction, 3) backfill of underground stopes as they are mined, 4) construction of berms for safety and visual screening purposes, percolation ponds and the tailing impoundment, and 5) use as reclamation materials such as cover soils, subsoils or rock armor.

### 2.3.7 Mine Water Use and Management

All water used on site comes from one of three sources: potable wells, the Stillwater River, and appropriated groundwater encountered during the mining operation (adit water).

### 2.3.7.1 Potable Water

The existing east- and west-side potable water wells are tied together through a common distribution system to supply the surface support facilities and underground mine workings. Each well has a capacity of 200 gpm, and is demand activated. In order to partially mitigate water quality impacts and reduce water handling cost, SMC is discontinuing the practice of pumping fresh water underground as a source of potable water and drill water. Therefore, no additional potable water wells are proposed as part of this amendment.

### 2.3.7.2 Stillwater River Water

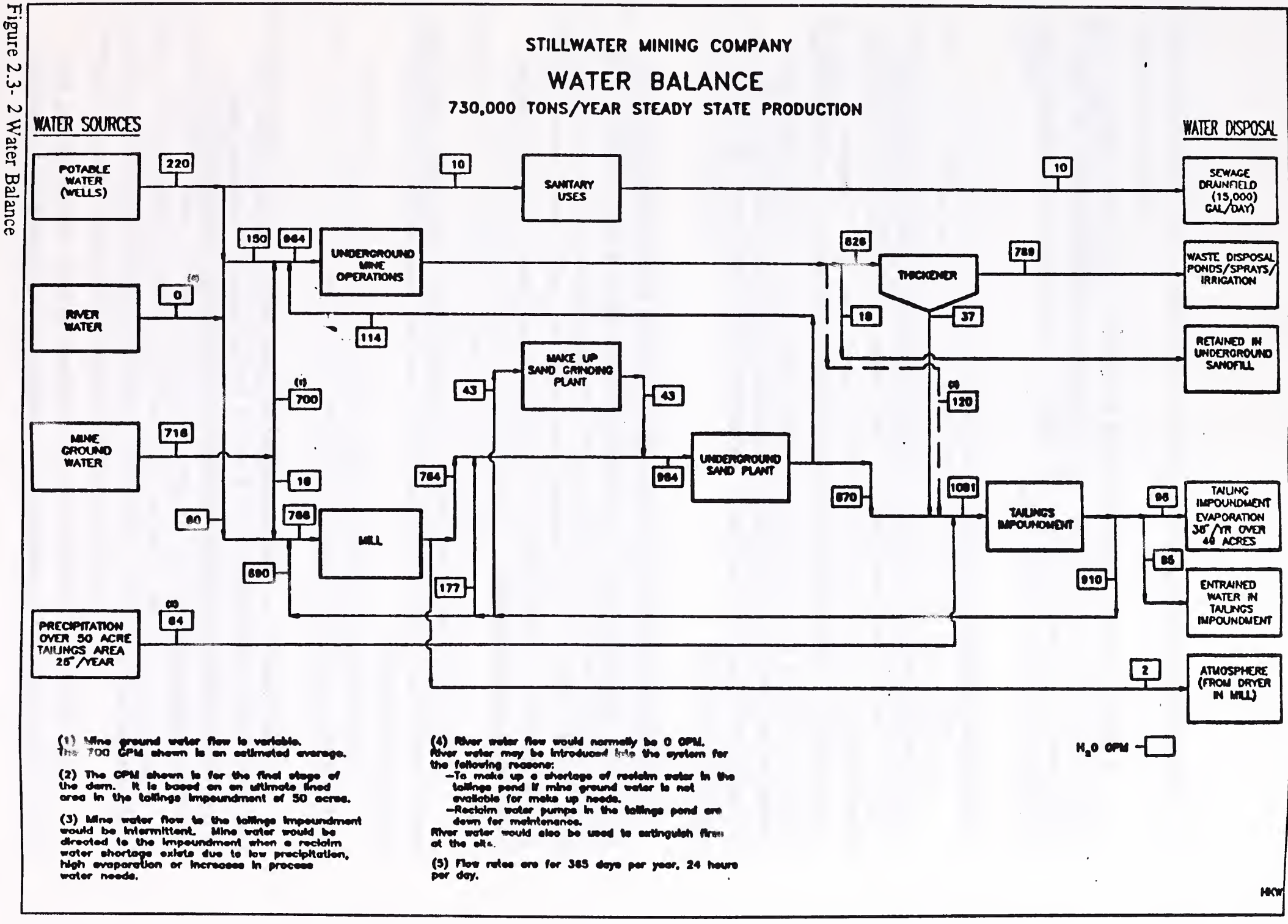
SMC has water right to use water from the Stillwater River to supplement mill make-up water, if required, through use of a 1,000-gpm electric pump. River water is also used for fire protection, through a dedicated supply system. The fire water system is supplied by a demand-activated diesel pumping system capable of supplying 1,000 gpm. Supplemental use of Stillwater River water is infrequent.

### 2.3.7.3 Adit Water

Currently, the combined total adit water flow from both the west- and east-side mining activities is made up of approximately 90 gpm from the sandfill process, 120 gpm from mining sources (i.e. drilling, dust suppression), and approximately 514 gpm from groundwater. This 724 gpm total is referred to as adit water and is currently routed for treatment prior to utilization or disposal. This treatment consists of clarification on both the east and west sides for solids removal. The clarifiers remove fine particulate (slimes) leaving the treated water free for use in the irrigation of reclamation, for soil stabilization, dust control, or for use as mill process make-up water. Excess water is routed to the sedimentation/percolation ponds for disposal.

Periodically, higher flows result from the interception of water which has been stored in faults and fractures. These fractures, faults, and shear zones may be dewatered as mining continues. Consequently, large quantities of adit water may be generated for short periods of time. This water would be used for irrigation through existing mine water systems, diverted to the tailing impoundment for use as mill make-up water, or diverted to percolation ponds and/or the emergency containment basins. In areas where water-bearing structures are intercepted by mine development and no stoping is planned, grouting techniques may be used to slow inflows. In the case of a drill hole, a packer may be installed.

Figure 2.3- 2 Water Balance


STILLWATER MINING COMPANY
WATER BALANCE
730,000 TONS/YEAR STEADY STATE PRODUCTION
WATER SOURCES
WATER DISPOSAL
POTABLE WATER (WELLS)
220
10
SANITARY USES
10
SEWAGE DRAINFIELD (15,000) GAL/DAY)
150
964
UNDERGROUND MINE OPERATIONS
828
THICKENER
789
WASTE DISPOSAL PONDS/SPRAYS/ IRRIGATION
RIVER WATER
(4)
0
18
37
114
RETAINED IN UNDERGROUND SANDFILL
MAKE UP SAND GRINDING PLANT
43
43
(1)
700
(3)
120
MINE GROUND WATER
718
UNDERGROUND SAND PLANT
984
764
18
1081
870
TAILINGS IMPOUNDMENT
98
TAILING IMPOUNDMENT EVAPORATION 36"/YR OVER 40 ACRES
80
766
MILL
85
890
910
ENTRAINED WATER IN TAILINGS IMPOUNDMENT
177
(2)
64
PRECIPITATION OVER 50 ACRE TAILINGS AREA 25"/YEAR
2
ATMOSPHERE (FROM DRYER IN MILL)
H2O GPM
(1) Mine ground water flow is variable. The 700 GPM shown is an estimated average.
(2) The GPM shown is for the final stage of the dam. It is based on an ultimate lined area in the tailings impoundment of 50 acres.
(3) Mine water flow to the tailings impoundment would be intermittent. Mine water would be directed to the impoundment when a reclaim water shortage exists due to low precipitation, high evaporation or increases in process water needs.
(4) River water flow would normally be 0 GPM. River water may be introduced into the system for the following reasons:
–To make up a shortage of reclaim water in the tailings pond if mine ground water is not available for make up needs.
–Reclaim water pumps in the tailings pond are down for maintenance.
River water would also be used to extinguish fires at the mill.
(5) Flow rates are for 365 days per year, 24 hours per day.
HKW

2.3.7.4 Project Water Management

A general project water balance is shown in Figure 2.3-2. Under normal conditions, a water balance is maintained by a closed-loop system. During periods when process water in the tailing pond is excess, the adit water is directed to the clarifiers for cleaning and subsequent disposal, either by irrigation, evaporation, or by percolation.

2.3.8 Energy Consumption and Source

At this time, Montana Power Company (MPC) is capable of providing the project with 8 megawatts of power through the existing power lines. Present maximum demand is 5.8 megawatts. Planned upgrades in power supply lines by MPC could increase capacity to 11 megawatts by the summer of 1992. MPC is replacing the existing line because of deterioration in the 60-year old line, relocation of Highway 78, and increased loads in the Columbus area. MPC's anticipated power demand for mine production at 2,000 tpd is approximately 12 megawatts. Additional improvements planned by MPC which will be completed in 1993 would increase capacity well above SMC's anticipated requirements.

Most electrical power lines serving underground workings would be routed between mine levels through internal drill holes. When feasible, power requirements at portal sites during portal development would be supplied by running a power line through internal boreholes from a lower level. At times, however it may be necessary to temporarily use a standby diesel-powered generator at the development site until internal power line routes can be established. These generators may vary in size from 1.5 to 500 kW.

On rare occasions and for short periods of time, generated power may exceed 1 megawatt in order to maintain mine ventilation systems and critical power during emergencies and planned temporary power outages.

2.3.9 Roads

No modifications to the permitted transportation system within the permit boundary or to external public transportation systems (FAS 419 or FS 846) are proposed via this amendment. However, the mill complex access may be relocated to the north end of the existing mine water overflow pond (Figure 2.3-1).

2.3.10 Equipment

Equipment at the mine facility consists of locomotives, muck cars, flat cars, jumbos, load, haul, and dump (LHD) vehicles, jacklegs/stopers, underground trucks, diamond drills, raise borers,

dump trucks, front-end loaders, flatbed trucks (low boy), pickups, tunnel boring machine, and personnel vans and buses.

### 2.3.11 Surface Support Facilities

West Side

The existing west-side facilities have been approved via previous amendments. Further detail related to these facilities may be found in either the 1985 EIS or 1989 East Side EA/PER. This discussion deals only with the changes proposed by SMC in this application. For additional facilities location details refer to Figure 2.3-1.

Mill Building

Changes in the size and configuration of the mill building would be needed to accommodate the expansion. The expanded mill facility would occupy the area directly north of the mill in the area occupied by mill maintenance.

Additionally, the employees' change room would be enlarged to accommodate the additional 65 workers. Increased office space for administrative staff may also be necessary.

Parking Lot

An estimated expansion of 100 feet by 200 feet is planned adjacent to the present employee parking lot to replace parking lost to expansion of the mill facility.

Additional Laydown Areas

Additional laydown areas would be needed to handle the storage of bulk mine and mill supplies. Approximately 3 to 5 acres would be required on the west side for this purpose.

Mine Equipment/Truck Shop/Warehouse and Mill Shop Relocation

The warehouse would need additional room to store and control the expanded inventory of supplies and machine parts. Similarly, the current truck shop and mill maintenance shop would be enlarged. To accommodate this growth, a new truck shop, warehouse, and mill shop are being proposed in the area directly adjacent to the existing security office. Additionally, this location could be changed should the ore dump pocket be moved behind the current mill area.

East Side

SMC proposed that the currently permitted (not yet constructed) building near the 5000 East Adit location would be expanded to provide storage and administrative space for the east side operation. This building would be approximately 60 by 300 feet in size and could contain offices, safety and training rooms, a warehouse area, change rooms, and a shop area for locomotive and equipment repairs. A septic and leach field system would be required to service this building. Additionally, a parking area would be required.

Compressors may be housed adjacent to the 5000 East Adit portal structure in a separate enclosure to allow utilization of their waste heat to assist in warming mine ventilation air.

Expansion would require additional storage for bulk supplies and materials. This would occur in the area north of the 5000 East Adit. A berm would be constructed and vegetated around this laydown area in order to minimize visual impacts. This additional laydown/storage area is on previously disturbed ground.

### 2.3.12 Mine Utilities

Mine utilities consisting of a sand-fill system and mine-ventilation system would not be changed as a result of this proposed amendment. Additional detail may be found in both the original 1985 EIS for the Stillwater Project or 1989 East Side EA/PER.

### 2.3.13 Security and Public Safety

Security at Stillwater mine is currently provided by SMC employees. At least one security guard is on duty in the security building on all shifts, and security is maintained 24 hours per day.

Access to the east side is secured by a locking barrier across the Stillwater River Bridge on weekends, holidays, or other periods when personnel are not on duty. It may become necessary in the future to add another security building of the east side of the river. Additionally, access roads from FS 846 into SMC's west side operating areas are also secured by means of locking barriers during those same periods. A 6-foot chain link fence surrounds the tailings impoundment and equipment storage areas to prevent unauthorized entry.

The existing guard shack/security office may be moved from its present location to an area below the mill building between the west side septic drainfield and the mine water overflow pond. A new access road off FAS 419 to the parking area would be constructed as part of this move.

### 2.3.14 Sewage Disposal

The main sewage collection system now serving the project is located near the mill on the west side. Sewage is routed to a treatment (septic) system and leach field, which has the capacity of approximately 13,000 gpd. SMC has evaluated the system and determined the increase in work force and relocation of the administrative group to the mill building would require additional sewage handling capacity. This capacity can be obtained through enlargement of the existing leach field or addition of a second system. Figure 2.3-1 indicates the location of this second system.

There are currently no permanent buildings on the east side. Sewage from the east side operation is contained in portable sanitary facilities, which are pumped every two weeks. Plans for a building which would house a locomotive repair shop, air compressors, change room, warehouse, and mine offices on the east side would require installation of a permanent sewage treatment system. Figure 2.3-1 shows the approximate location of this system on the east side.

### 2.3.15 Solid Waste

Waste material from the operation is segregated as much as practical for recycling. Steel and wood are separated from conventional waste material. Steel is sold to a recycler. Scrap wood is made available to mine employees for use as firewood, burned, or disposed of by the County Solid Waste District. Other conventional waste from the operation is disposed of through the Stillwater County Solid Waste System. Any waste classified as hazardous would continue to be disposed of in accordance with applicable local, state and federal laws, rules and regulations.

SMC's solid waste disposal practices were evaluated and approved in 1989 during a site inspection by the DHES. The present system of solid waste disposal would continue with increased emphasis on recycling.

### 2.3.16 Fire Protection

Fire protection is provided in accordance with MSHA and USFS safety requirements. On-site fire protection facilities include a dedicated, demand-activated diesel-driven pumping system which has a capacity of 1,000 gpm at 105 pounds per square inch (psi). This system draws water from the Stillwater River and distributes it to fire hydrants which are located at strategic points around the west side permit area. New facilities on both the west and east sides proposed via this amendment would also be connected to the current fire hydrant system. In addition, dry chemical A, B, and C type extinguishers are located on mobile equipment as well as throughout the mine and mill complex.

The Nye company of the Absarokee Volunteer Fire Department has a 4-wheel drive pump truck which was provided by SMC through a grant under the Amended Hard Rock Mining Economic Impact Plan (SMC, 1988). This vehicle is on call for emergencies county wide.

### 2.3.17 Personnel

The proposed expansion would increase mine employment from the current level of 365 to approximately 525 workers. Of the increase, approximately 50 percent are expected to be in-migrating. Employment level of 460 persons was evaluated in the East Side Expansion EA (DSL/FS, 1989) and the impacts addressed in the amended hard rock impact plan (SMC/Stillwater County, 1988). The addition of 65 more employees to presently permitted levels would not automatically trigger impact plan renegotiations.

Table 2.3-1 Proposed Personnel Requirements by Shift

| Shift | Mine and Maintenance | Mill | Staff | Total |
|---|---|---|---|---|
| Day | 183 | 9 | 21 | 213 |
| Day (12-hour shift) | 12 | 11 | 3 | 26 |
| Afternoon | 168 | 5 | 5 | 178 |
| Night | 75 | 5 | 2 | 82 |
| Night (12-hour shift) | 12 | 11 | 3 | 26 |
| TOTAL | 450 | 41 | 34 | 525 |

### 2.3.18 Project Closure and Reclamation

The stated life of this mining operation would be shortened by about 5 years if this amendment were approved. This figure is dependent on the tailing impoundment capacity. However, the ultimate life of the mine is dictated by metal values, productivity of the operation, and profitability.

The short-term objectives of the reclamation plan are to stabilize disturbed areas through erosion control, minimize visual impacts of operational disturbances, and prevent air and water pollution. This would be accomplished by a number of operational practices and interim revegetation.

The long-term objective of reclamation is to establish a post-operational environment that is compatible with the existing land uses of the area. Of particular importance is returning disturbed areas within the CNF to a state consistent with the long-term goals as stated in the CNF Land and Resource Management Plan.

SMC's reclamation plan is based on analysis of baseline environmental data, review of current reclamation literature, and three years of on-going reclamation efforts. The plan incorporates many

of the goals of the CNF management plan, as well as the Metal Mine Reclamation Act. Specific post-operational land use objectives include:

Permanent protection for air, surface water, and groundwater resources;
Protection of public health and safety by removal of potential hazards;
Establishment of a land configuration compatible in the watershed;
Reestablishment of an aesthetic environment allowing for visual quality and recreational opportunity; and
Reestablishmment of post-operational biological potential suitable for supporting vegetative cover and wildlife habitat appropriate to the area.

2.3.18.1 Tailings Impoundment

Expansion of the tailing impoundment as proposed would result in a final crest elevation of 5,125 feet (maximum height of the tailing liner), and the impoundment would cover 70 acres. A 3-foot high berm constructed on the crest for freeboard purposes would remain for reclamation, bringing the final maximum elevation to 5,128 feet. The embankment would continue to be constructed in lifts utilizing conventional waste rock and waste rock generated by the Tunnel Boring Machine (TBM).

Tailing reclamation would consist of dewatering, cap and soil placement, and revegetation of the impoundment surface as well as armoring the embankment to provide for stabilization. Resoiling, revegetation, and further specifics of tailing dewatering are discussed in detail in Section 4.1 of the 1988 East Side Expansion Plan of Operations amendment.

2.3.18.2 Grading

After the tailing has been sufficiently dewatered to support construction equipment, the tailing surface would be graded as indicated in Figure 2.3-3 (plan view) and 2.3-4 (cross section). Tailing would be bulldozed to prevent runoff over the embankment face and to account for differential settling. It is estimated that following the 2 years after reclamation, settlements of up to 2 feet could occur near the center of the impoundment where the depth of tailings is the greatest. Smaller amounts of settlement would occur towards the edges of the impoundment. Additional settlement of 3 inches is anticipated during the next 3 years. Regrading would result in some compaction; however, final contour would take into account final settlement so that depressions would not occur.

Grading of tailing or waste rock would be conducted so that a minimum of one percent slope (post-settlement) away from the embankment will be achieved. Surface drainage from the impoundment would be collected by the perimeter drainage ditch and flow around the ends of the

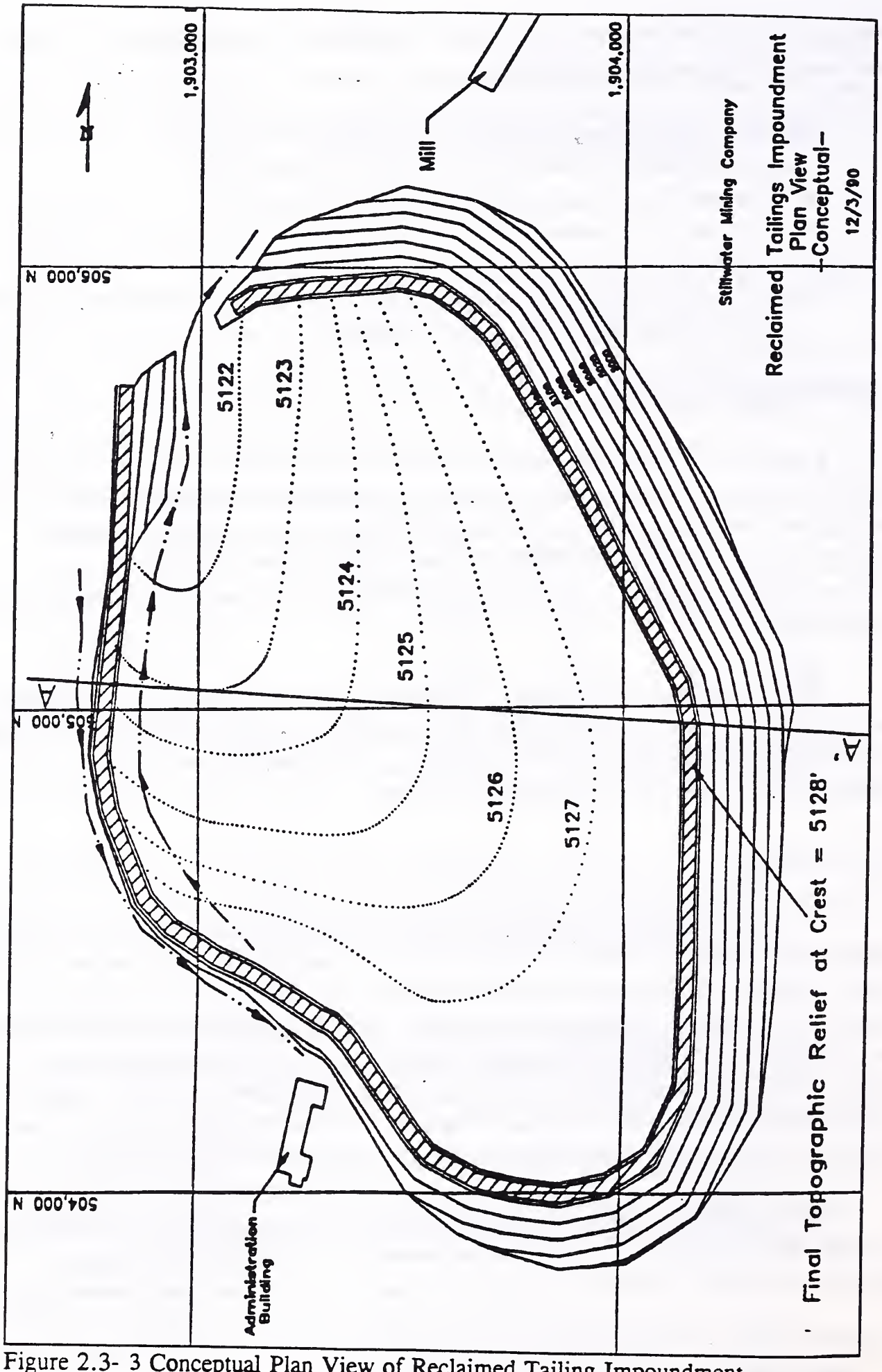



Figure 2.3- 3 Conceptual Plan View of Reclaimed Tailing Impoundment

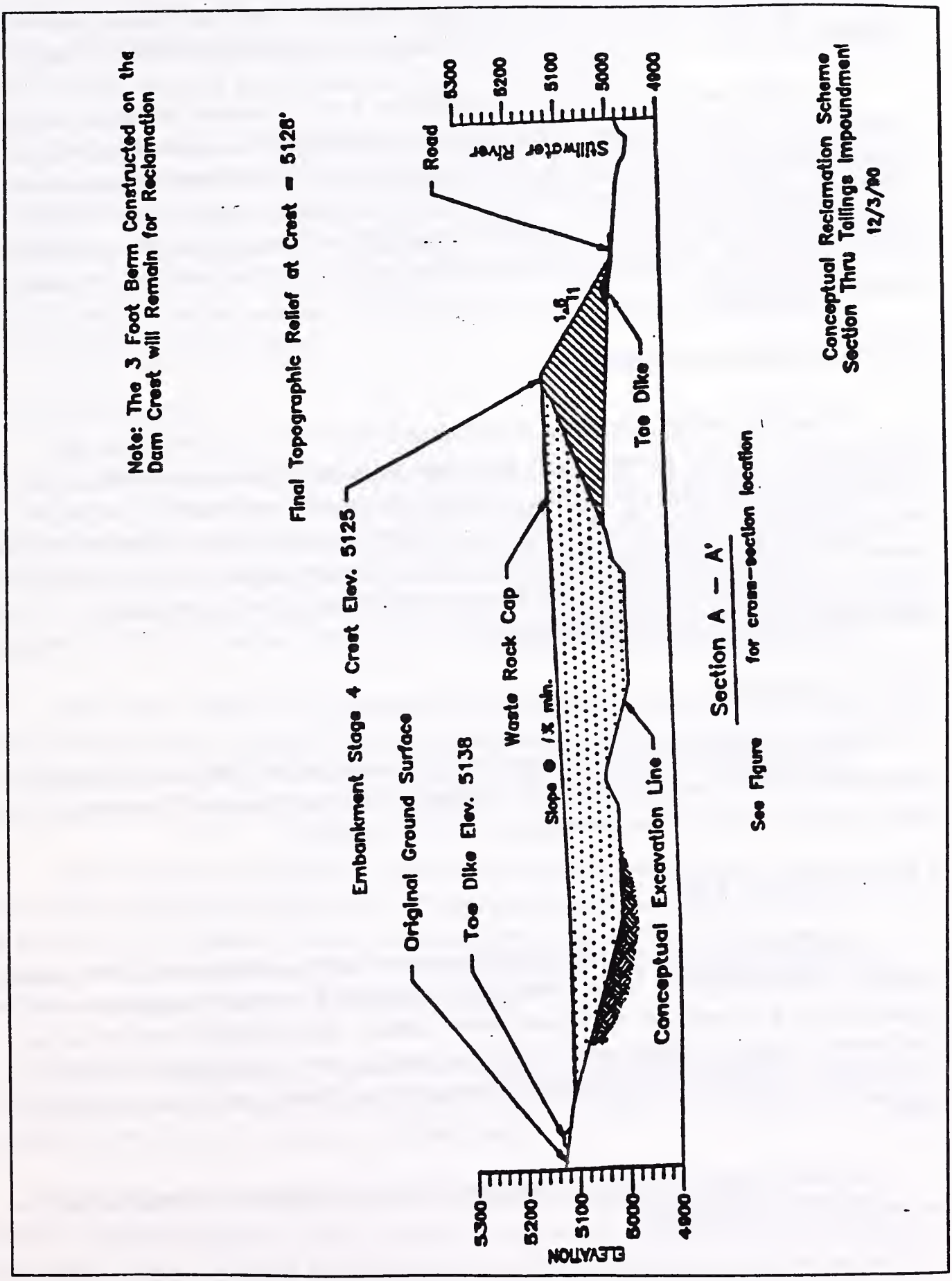



Figure 2.3- 4 Conceptual Reclamation Scheme -- Section through Tailings Impoundment

impoundment into natural channels. In areas of the impoundment where the tailing may be difficult to dewater, the tailing would be covered with mine waste rock to achieve post-operation design.

The tailing would have a low bearing capacity and it may be necessary to provide subgrade reinforcement. Such reinforcement typically consists of subgrade stabilization fabric which would prevent bearing failure caused by the weight of the mine waste rock and construction equipment. The stabilization fabric would not act as a filter between the two materials to prevent the tailing from migrating into the mine waste rock. In addition to a stabilization fabric, a filter fabric or material may have to be used. A layer of sand or sandy soil spread onto the tailing surface may be used instead of a filter fabric.

#### 2.3.18.3 Embankment Stabilization

The existing tailings embankment is constructed of mine waste rock (conventional and TBM-generated). At final reclamation, all downstream slopes constructed at approximately 1.6h:1v would remain as constructed. The steeper, reinforced embankment slopes constructed at 1.2h:1v would be reduced to 1.6h:1v at final reclamation. The final downstream slopes of the dam would be covered with riprap to reduce erosion potential. Coarse mine waste rock and on-site boulders and cobbles would be utilized for riprap. This riprap would be placed on the dam face during construction of the final stage of the embankment.

#### 2.3.18.4 Dust Control

Final revegetation of disturbed areas other than the tailing embankment would mitigate any post-operation dust. A rock mulch, sprinkler, or chemical binder may be used, if necessary, to control dust while tailing is being dewatered prior to final revegetation.

#### 2.3.18.5 Waste Rock Storage

All existing topsoil would be stripped from waste-rock storage areas prior to addition of waste materials. Existing topography will be utilized when constructing the waste-rock stockpiles in order to maximize visual screening potential of each storage location. Diversion ditches would be put in place during construction to divert surface water away from the waste-rock stockpiles. The final crest of the stockpiles would be backsloped towards natural ground to minimize runoff over waste-rock slopes.

Permanent storage areas would be constructed in lifts with maximum slopes of 2h:1v to allow for resoiling prior to revegetation.

Temporary storage areas would be prepared for interim revegetation once storage capacity has been reached. Once waste is removed from the temporary storage areas the site would be recontoured, resoiled and permanently revegetated. A typical cross section of a waste-rock stockpile and the east-side waste-rock berm is shown in Figures 2.3-5 and 2.3-6.

The proposed east-side waste berm/visual screen may be constructed in several segments rather than using lengthwise lifts in order to allow for timely reclamation on downstream slopes and to avoid disturbing large areas of chrome tailings at one time. The downstream face of the berm would have a maximum slope of 2h:1v which would be resoiled and revegetated when construction on the segment is complete. The inside, or upstream, face would be left at the angle of repose and would be faced with coarser waste rock until final reclamation, at which time it would also be contoured, topsoiled and revegetated.

2.3.18.6 Soil Handling

Excavation for the tailing impoundment, mill and mill complex, and percolation pond area on the west side initially provided an estimated 18,500 loose cubic yards (lcy) of soil which were stockpiled for later use in final reclamation of the tailing impoundment, mill site, and associated facilities. Approximately 10,000 lcy of soil were excavated and stockpiled during Stage 2 construction of the tailings impoundment in 1989. Excavation of percolation and sedimentation ponds during fall of 1990 yielded another 2,500 lcy of topsoil which were stockpiled near the pond site.

Approximately 6,000 lcy of soil materials were direct hauled to the 5300 West and 5500 West portal patios from Stage 2 excavation of the tailings impoundment. These materials were distributed on the faces of the portal patio slopes and revegetated during spring of 1989. These slopes, as contoured and revegetated, constitute final reclamation.

Soil salvaged from the tailing and facilities areas is stored in three stockpiles located adjacent to the tailing disposal site (see Figure 2.3-1). The storage piles have maximum side slopes of 2h:1v, and a minimum surface slope of 2 percent to promote surface drainage. The stockpiles were revegetated during spring 1987 and 1989. If stockpiles are disturbed by adding salvageable soils in the future, they would be revegetated as soon as practical.

Table 2.3-2 summarizes the volumes of soil salvaged from the existing facilities. Additional soil materials encountered during expansion activities would be salvaged where appropriate and either stockpiled or direct hauled, if possible, to applicable sites.

Soil salvage difficulties (large boulders) precluded the salvage of originally estimated soil volumes. The existing stockpile allows an average distribution depth of about 3 inches on the tailing impoundment surface. Because of the relative paucity of cover soil, tailing and waste rock are being

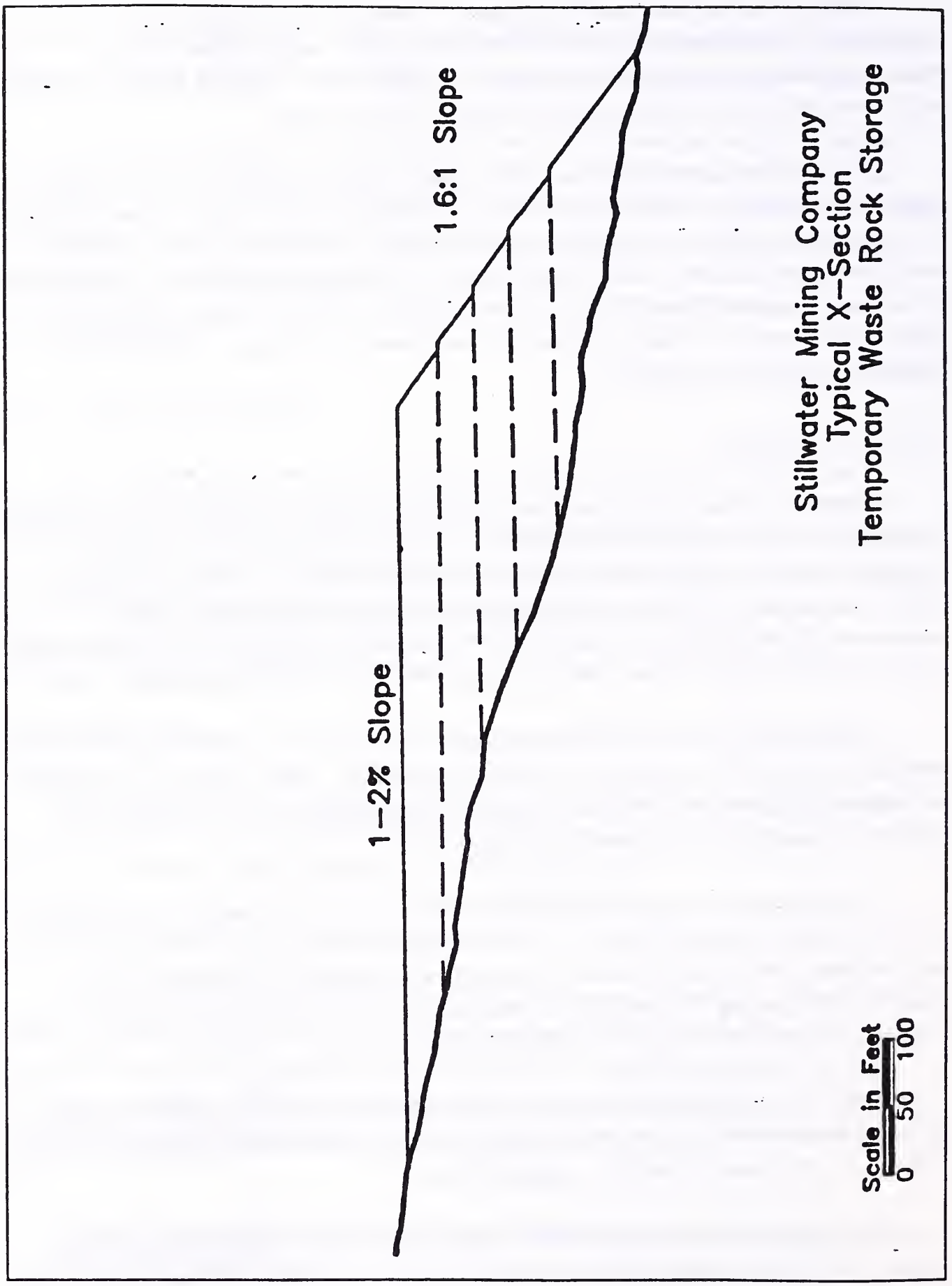



Figure 2.3-5 Typical Cross Section -- Temporary Waste Rock Storage

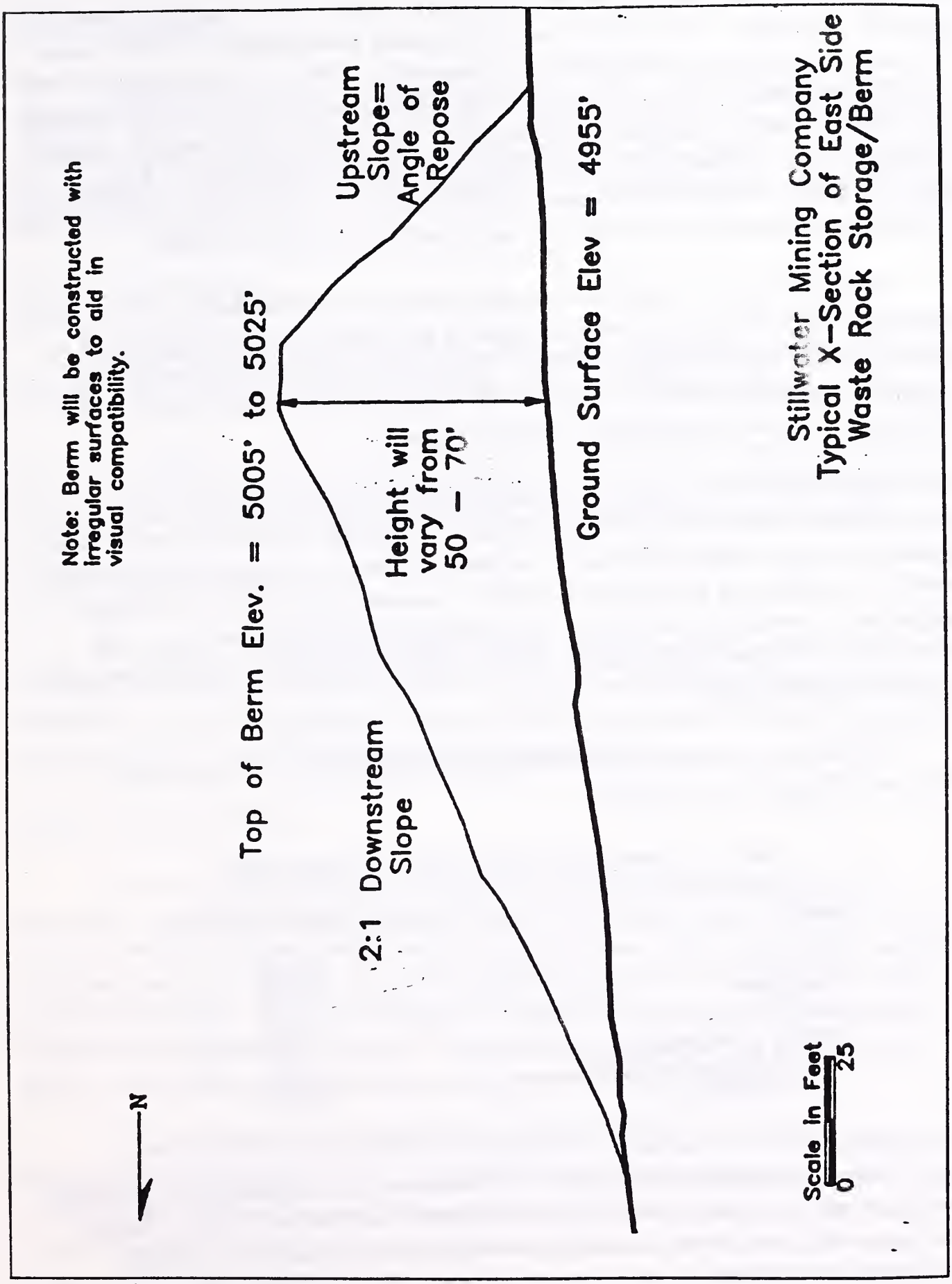

Note: Berm will be constructed with irregular surfaces to aid in visual compatibility.
Top of Berm Elev. = 5005' to 5025'
Upstream Slope= Angle of Repose
Height will vary from 50 - 70'
2:1 Downstream Slope
Ground Surface Elev = 4955'
Stillwater Mining Company
Typical X-Section of East Side
Waste Rock Storage/Berm
N
Scale in Feet
0
25

Figure 2.3-6 Typical Cross Section of East Side Waste Rock Storage/Berm

reevaluated for use as a cover soil or subsoil. Preliminary analyses of waste materials indicated no phytotoxic characteristics. TBM-generated waste rock contains more fines than conventional waste rock and may provide a more suitable medium for revegetation. TBM waste has been physically and chemically characterized and on-site revegetation trials are being conducted. Early results from these trials indicate that with the addition of soil amendments, TBM waste can support adequate vegetation for at least 2 years. Detailed characterization of the waste rock and tailing is found in Sections 4.1.4 of the 1988 East Side Expansion Amendment. Refer to Sections 4.1.4, 4.2.3, 4.3.4, and 4.4.2 of the 1988 East Side Expansion Amendment for site specific details on soil handling practices.

Salvaged soil from new disturbances located in the area of the tailing facility would be hauled to and stored in the soil storage area near the upwind air monitoring site, labeled as Stockpile B on Table 2.3-2. As discussed on pages 4-12 and 4-13 of the application, this storage area would be revegetated after soils are added and the stock pile is recontoured. Soils salvaged from waste rock storage areas would be stockpiled adjacent to those storage areas.

Soils volumes to be salvaged from the areas of future disturbance were not given since estimates can vary widely and are site-specific in nature. Soil salvage estimates have been extremely inaccurate due to the variability of the terrain. Additionally, historic disturbances and activities have resulted in a real deficiency in salvageable soils. SMC is committed to the removal of salvageable soils prior to any new disturbance of ground and will continue this policy into the future. The salvaged soil would be stockpiled, stabilized, and the volumes reported to the agencies as required in the annual reclamation report.

The following table summarizes the volumes of soil now in the five existing stockpiles. Please refer to Figure 2.3-1 for locations.

Table 2.3-2 Summary of Volume of Soil in Existing Stockpiles

| SITE | VOLUME OF SOIL (lcy) |
|---|---|
| Stockpile A | 17,000 |
| Stockpile B | 10,000 |
| Stockpile C | 1,500 |
| 5300W Level Stockpile | 1,000 |
| 1990 Perc Pond Stockpile | 2,500 |
| TOTAL | 32,000 |

A waste rock sampling/testing program would be initiated on an as-needed basis if substantial quantities of a nontested (foreign) waste rock type are generated during mining activities. Atypical waste rock would be tested for toxic characteristics and acid-generating potential to determine suitability for use in reclamation.

### 2.3.18.7 Revegetation

Revegetation procedures would be carried out on the tailings facility and on all surface facilities as outlined in the existing reclamation plan. These revegetation practices and specifics such as species selection, revegetation mixtures, seedbed preparation, seeding methods, cultural treatments, and revegetation monitoring can be found in Sections 4.1.5, 4.2.4, 4.3.5, and 4.4.3 of the 1988 East Side Expansion Amendment.

### 2.3.18.8 Surface Facilities

This broad category includes the mill area, office area, sedimentation, percolation and emergency ponds, service corridors, laydown areas, wells, portal facilities, and roads.

New facilities created by the expansion would be treated in the same manner as existing facilities at the time of mine closure. Refer to Sections 4.2 and 4.4 of the 1988 East Side Expansion Amendment for facility removal and reclamation procedures specified for the surface facilities.

### 2.3.18.9 Mine Workings

The currently permitted mine workings consist of underground facilities (adits, drifts, crosscuts, and manways), 16 portals associated with 17 adits, two headframe/shaft areas and miscellaneous mine-related disturbances. Reclamation and closure of these workings are discussed in detail in Section 4.3 of the 1988 East Side Expansion Amendment.

### 2.3.18.10 Facility Removal

The present plan calls for removal of all surface facilities and structures during final reclamation. At this time, however, it is impossible to predict whether it may be beneficial to leave any of the structures associated with the project in place after mine closure. No structure would be left unless it provides a beneficial use, and its existence is approved by the appropriate regulatory agencies or landowner. The railroads and conveyor systems on the mine and mill site would be salvaged, and/or appropriately disposed of. Materials of no salvage value, such as concrete and asphalt, will be buried or covered at the site, or disposed of at an approved disposal site.

All service corridors (e.g., power, above-ground water lines) that are the responsibility of SMC would be removed at mine closure, and disturbed areas would be reclaimed as necessary. Any service corridors that would not serve a future beneficial use, or that are a responsibility of SMC, would be removed at mine closure, and disturbed areas would be reclaimed as necessary. Any service corridors that would serve a future beneficial use, or that are not a responsibility of SMC, would remain in place if approved by the appropriate regulatory agencies.

All salvageable materials (e.g., exhaust fans, rails) from the underground workings would be removed and sold or transferred to other operations. Any non-salvageable material (e.g., timber, rail ties, gates, pipe, etc.) would be left in place and buried at final reclamation.

### 2.3.18.11 Mine Drainage

The underground workings are expected to continue to produce water after mining activities cease. The drainage would exit the workings and enter sedimentation/percolation ponds. The quality of this water is expected to be better than that produced during operations since there would be no underground activity generating sediment or nitrogen compounds from blasting. The post-closure drainage water quality is expected to approximate the groundwater quality in the region.

Following mine closure, the drainage ditches/piping, and percolation ponds near the 5000 East portal would remain in place to receive any continued flow of adit water from the 5000 East portal. Existing ponds on the west side would be reclaimed and replaced by new ponds located near and below the 5000 West portal. During final reclamation of the mill site and adjacent parking area, the percolation and sedimentation ponds would be incorporated. These ponds would receive gravity flows from the 5000 West portal. SMC would bear the maintenance responsibility of the east- and west-side water facilities, as covered under the MPDES permit. After the expiration of the MPDES permit, SMC, or any successor, would be responsible for any necessary maintenance or reclamation.

### 2.3.18.12 Estimated Reclamation Units and Costs

SMC estimated reclamation costs for the project at $1.7 million. This would include reclaiming the tailing impoundment, waste-rock stockpiles, mill/mine support facilities, mine workings, and roads.

## 2.3.19 Water Resources Monitoring Plan

The operational water resources monitoring plan for SMC was originally developed in 1986 and has been modified to include expansion on the east side in 1988 and construction of additional percolation ponds in 1990. A summary of the current monitoring program appears in Table 2.3-3. Figure 3.2-1 (Chapter 3) shows location of sampling sites.

Hydrological data for 1986-90 are included in annual reports submitted to both the DSL and DHES-WQB. No changes in the current operating monitoring plan or reporting procedures are proposed by SMC.

Table 2.3-3 Water Resources Monitoring Plan — 1990 Operational Monitoring Stillwater Mining Company

| Station | Location | Spring (High Flow) | Summer (Low Flow) | Fall/Winter (Low Flow) |
|---|---|---|---|---|
| **SURFACE WATER** | | | | |
| SMC-1A | Upstream Stillwater River | X | X | X |
| SMC-2 | Downstream Stillwater River | X | X | X |
| SMC-3 | West Side Mine Adit Discharge at Clarifier | X | X | X |
| SMC-4 | Decant water at mill | X | X | X |
| SMC-5 | Upstream Mountain View Creek | X | X | X |
| SMC-6 | Downstream Mountain View creek | X | X | X |
| SMC-7 | Nye Creek | X | (1) | (1) |
| SMC-7D | Nye Creek below Percolation Ponds | X | X | X |
| SMC-8 | No Name Creek | X | (1) | (1) |
| SMC-9 | East Side Adit Discharge at Clarifier | X | X | X |
| SMC-10 | Stillwater Ranch below Stillwater Valley Ranch | X | X | X |

| Station | Location | Winter | Spring | Summer | Fall |
|---|---|---|---|---|---|
| **GROUNDWATER (2)** | | | | | |
| MW-5A | Downgradient tailing pond, shallow | X | X | X | X |
| MW-6A | Downgradient tailing pond, shallow | X | X | X | X |
| MW-7A | Downgradient tailing pond, shallow | X | X | X | X |
| MW-7B | Downgradient tailing pond, medium | X | X | X | X |
| MW-7C | Downgradient tailing pond, deep | X | X | X | X |
| MW-9 | Downgradient tailing pond, shallow | X | X | X | X |
| MW-10 | Upgradient tailing pond, shallow | X | X | X | X |
| MW-11 | Downgradient tailing pond, shallow | X | X | X | X |
| T-1A | Upgradient Sed/Perc ponds, shallow | X | X | X | X |
| T-2 | Downgradient Sed/Perc ponds, shallow | X | X | X | X |
| T-3A | Downgradient Sed/Perc ponds, shallow | X | X | X | X |
| MW-12A | Downgradient SVR Perc ponds | X | X | X | * |
| MW-13A | Downgradient SVR Perc ponds | X | X | X | * |
| MW-14A | Upgradient SVR Perc ponds | X | X | X | * |
| MW-15A | Downgradient SVR Perc ponds | X | X | X | * |

| Station | Location | Monitoring Frequency Spring | Summer | Fall |
|---|---|---|---|---|
| | **SPRINGS** | | | |
| SP-1 | Upper Jones Spring - T5S, R15E, SE¼, Sec. 8 | | (3) | |
| SP-2 | Buffalo Jump Spring - T5S, R15E, SE¼, NW¼, Sec. 2 | | (3) | |
| SP-3 | East Side Spring - T5S, R15E, SE¼, NW¼, Sec. 22 | X | (3) | X |

NOTES:

(1) Samples will be collected if streams are flowing.

(2) Water Levels in all monitoring wells will be measured monthly

(3) Flow monitoring of springs will be conducted during the summer low flow period in early August.

* New wells added in 1990, sampled in November and Deceember 1990, and January 1991.

SOURCE: SMC, 1991b

SMC also is required to monitor adit flows and discharge according to the terms of the current MPDES permit. This data is reported directly to the WQB and entered into EPA's nation-wide computerized database (Permit Compliance System).

SMC also maintains an extended voluntary monitoring network outside of the required operational monitoring plan. This program is a cooperative effort between SMC and adjacent landowners to establish flow and water quality for the numerous streams and springs which occur within the overlying drainage. As a voluntary plan, SMC may alter the frequencies and/or monitoring points as concerns or conditions dictate.

### 2.3.20 Petition for Modification of Quality of Ambient Waters

The proposed Amendment No. 008 to increase the production rate to 2,000 tpd may increase the chemical load (mass of a chemical compound or element in water) of nitrogen compounds and metals discharged to groundwater or surface water since mining would proceed at a faster rate. The petition requests a change in the water quality limits for groundwater, and for surface water in the Stillwater River to concentrations higher than the ambient concentrations. These changes would not cause calculable or measurable exceedances of applicable (numeric) water quality standards.

Percolation from disposal ponds (after clarification) at SMC would result in changes in the quality of ambient groundwater in the vicinity of the ponds and in the surface water in the Stillwater River. Direct discharge of adit water to the Stillwater River would result in changes in the quality of ambient water in the Stillwater River. The groundwater and surface water quality resulting from adit water discharge would not cause calculable or detectable exceedances of applicable water quality standards. Table 2.3-4 indicates the maximum modifications of ambient water quality requested for the proposed water discharges.

SMC believes that anticipated impacts follow worst-case assumptions which may not materialize in actual mining conditions. SMC believes that current information suggests degradation of surface and groundwaters outside SMC's permit area has been undetectable at the present mining production rate. Expansion of the mining rate will only access the same ore body at a faster rate and may not increase concentration of minerals and deleterious substances in detectable quantities outside the permit area.

SMC estimates that the proposed production increase (Amendment No. 008) would result in an average excess adit water disposal rate of 789 gpm (Plan of Operation, page 2-14). This is an increase of 289 gpm over the current rate. To partially mitigate water quality impacts and reduce operating costs, SMC is discontinuing the practice of pumping fresh water underground as a source of drill water (up to 150 gpm). Clarified adit water will be recycled as drill water, which will reduce adit water discharges.

SMC uses all of the adit water for spray irrigation for approximately 6 months of the growing season. During the remainder of the year, adit water is routed to percolation ponds for discharge to groundwater. Adit water from either the east and west sides can be routed to any of the ponds.

Table 2.3-4 Requested Change in Water Quality Limits (1)

| Parameter | Montana Surface Water Quality Standard | Requested Surface Water Quality Limit | Montana Groundwater Quality Standard | Requested Groundwater Quality Limit |
|---|---|---|---|---|
| TDS | 250 | 200 | No standard | 200 |
| Nitrate+Nitrite | 10 | 2 | 10 | 8 |
| Ammonia | 1.18 | 0.4 | No standard | |
| Copper | 0.003 | 0.01* | No standard | |
| Chromium (2) | 0.011 | 0.005 | 0.05 | 0.02 |
| Iron | 0.3 | 0.2 | No standard | |
| Lead | 0.0004 | 0.002* | 0.05 | 0.01 |
| Manganese | 0.05 | 0.03 | No standard | |
| Nickel | 0.013 | 0.01* | No standard | |
| Zinc | 0.027 | 0.015 | No standard | |

(1) All values are in mg/L. Surface water standards and limits are for total recoverable metals. Groundwater quality standards and limits are for dissolved metals.

(2) Water quality standards are for hexavalent chromium. Requested limits are for total chromium, including hexavalent ($Cr^{+6}$) and trivalent ($Cr^{+3}$) chromium.

* Value shown is the analytical detection limit.

SOURCE: SMC, 1991b

Current pond capacity is in excess of that required for current adit flows, and anticipated increased flows as mining progresses.

SMC is also permitted to discharge water from the east and west adits to the Stillwater River under the terms of the existing MPDES permit (No. 0024716). There has been no point (source) discharge of water into the Stillwater River since operations began in 1986.

## 2.4 Alternative 3 - Modifications Concerning Tailings Impoundments

### 2.4.1 Introduction

Four different tailing-amendment options will be analyzed. To facilitate understanding and comparison of these options, all four will be discussed in Alternative 3 as 3a (No Action), 3b (Company Proposal), 3c (Partial Approved) and 3d (Approved with Modification). Table 2.4-1 shows specifications for each option. Impacts to other resources may be specific to an option or may be examined in general terms.

### 2.4.2 Decision-Makers' Selection

The decision makers, Beartooth Ranger District and Commissioner of State Lands would incorporate one of these Alternative 3 options: 3a, 3b, 3c, or 3d, with other alternatives. For example, Impoundment Alternative 3d could be incorporated into either the Company's Proposal (Alternative 2) or the Proposed Action with Modifications (Alternative 5). This allows flexibility to the decision makers while maintaining a fairly simple structure for analysis and impact disclosure.

### 2.4.3a No Action - 3a

The no-action alternative for tailing impoundments denies SMC's proposal because it limits production of the mine to 1,000 tpd. All currently permitted activities could continue. The tailing impoundment is currently permitted to be constructed in stages. Stages I and II are complete. Stage III construction would begin in 1992 and would be completed in 1997. Stage IV would begin construction in 1997, with completion in 2000. At the maximum tailing production rate for 1,000 tpd ore production, the impoundment life would extend through the year 2013. The reclamation plan, which calls for complete grass revegetation at 2h:1v slopes, would remain in effect.

Alternative 3a is included because it allows the decision makers to maintain presently-permitted levels.

### 2.4.3b Company's Proposal - 3b

In Alternative 3b SMC proposes to increase production to 2,000 tpd, while maintaining a long mine life. To accommodate the increased amount of tailing generated by doubling production, the impoundment area would be expanded by 4 acres and the height increased by 14 feet over presently permitted dimensions. Expansion would be augmented by steepening impoundment slopes to 1.6h:1v during both operation and reclamation. Impoundment capacity would be reached in 2008. Reclamation would be modified to rock armoring the slopes while maintaining grass vegetation on the impoundment surface.

Table 2.4-1 Tailing Impoundment Alternatives

| Impoundment Specifications | 3a. No Action | 3b. Company Proposal | 3c. Partial Approval | 3d. Modified Impoundment |
|---|---|---|---|---|
| Impoundment area | 66 acres | 70 acres | 66 acres | 75 acres |
| ponded area | 39 acres | 44 acres | 39 acres | 44 acres |
| embankment slope area | 54 acres | 42 acres | 54 acres | 62 acres |
| Dam crest elevation | 5,111 feet | 5,125 | 5,111 feet | 5,125 feet |
| width | 20 feet | 20 feet | 20 feet | 20 feet |
| maximum height | 141 feet | 155 feet | 141 feet | 155 feet |
| Freeboard above maximum tailing elevation | 9 feet | 4 feet, plus a 3-foot berm | 9 feet | 4 feet, plus a 3-foot berm |
| Storage capacity @ tailing elevation | 5,102 feet | 5,121 feet | 5,102 feet | 5,121 feet |
| cubic yards | $3.75 \times 10^6$ yd$^3$ | $5.3 \times 10^6$ yd$^3$ | $3.75 \times 10^6$ yd$^3$ | $5.3 \times 10^6$ yd$^3$ |
| tons of tailing @ average dry density = 70 lb/ft$^3$ | $3.5 \times 10^6$ tons | $5.0 \times 10^6$ tons | $3.5 \times 10^6$ tons | $5.0 \times 10^6$ tons |
| Embankment volume | $2.1 \times 10^6$ yd$^3$ | $2.7 \times 10^6$ yd$^3$ | $2.1 \times 10^6$ yd$^3$ | $3.1 \times 10^6$ yd$^3$ |
| impoundment borrow | 819,000 yd$^3$ | 819,000 yd$^3$ | 819,000 yd$^3$ | 819,000 yd$^3$ |
| waste rock fill | 1,281,000 yd$^3$ | 1,891,000 yd$^3$ | 1,281,000 yd$^3$ | $2.3 \times 10^6$yd$^3$ |
| efficiency ratio (embankment volume/impoundment volume) | .56 | .51 | .56 | .58 |
| Maximum tailing production rate | 380 tons per day | 760 tons per day | 760 tons per day | 760 tons per day |
| impoundment life | 22 years, through year 2013 | 17 years, through year 2008 | 12 years, through year 2003 | 17 years, through year 2008 |
| Maximum ore production rate | 1,000 tons per day | 2,000 tons per day | 2,000 tons per day | 2,000 tons per day |
| total ore production over life of the impoundment | $9.2 \times 10^6$ tons | $13.16 \times 10^6$ | $9.2 \times 10^6$ tons | $13.16 \times 10^6$ tons |
| Residual waste rock storage associated with the alternative and not used in construction or reclamation. | None | 330,000 yd$^3$ | None | A 250,000 yd$^3$ deficit. |
| Stability: minimum factors of safety against mass instability — static: / pseudostatic: (seismic) | 1.8 / 1.3 | 1.5 / 1.1 | 1.8 / 1.3 | ≤1.8 / ≤1.3 |

Alternative 3b is included because it is SMC's proposal, and allows expansion of tailing capacity with the least ground disturbance.

### 2.4.3c Partial Approval - 3c

The partial-approval alternative would allow SMC to expand production to 2,000 tpd, but would not allow modification of the tailing facility. Size, capacity, slopes and reclamation would all remain as presently permitted (see No-Action Alternative 3a and Stillwater EIS). Construction of Stage III of the facility would begin in 1992. SMC would be required to study impoundment questions including long-range options, in consultation with the agencies. A report and/or application would be due on or before January 1, 1995. With no impoundment modifications, the increased production rate would result in the filling of the permitted facility by 2003.

This alternative option was developed by the agencies in response to the existence of a number of uncertainties. Agency approval of increased production without increased tailing disposal capacity would substantially reduce mine life, or require disturbance for a new impoundment much sooner than planned. If a new water treatment plant were to be required, its placement might affect the geographic extent of this or future impoundments, or other processing operations. Appropriate planning is necessary to allow time for meaningful compliance with state and federal regulations.

### 2.4.3d Modified Impoundment - 3d

Under Alternative 3d, modified impoundment, production would increase to 2,000 tpd and the proposed tailing impoundment would be changed. Height would be increased 14 feet to elevation 5,125. The toe would be moved outward because of the increased height, expanding the total area to 75 acres. 2h:1v slopes and grass revegetation would be maintained as permitted, except along the south dam face, where FS Road No. 846 and Mountain View Creek are located. Here the dam would be steepened to 1.6h:1v and would be rock armored at reclamation. County Road FAS 419 would have to be relocated toward the Stillwater River to accommodate the increased impoundment size. These modifications increase capacity so that the facility's life would be the year 2008.

Alternative 3d was developed by the agencies in an attempt to increase capacity while maintaining 2h:1v slopes for stability and reclamation, and maintain impoundment life.

## 2.5 Alternative 4 - Water Treatment

During preliminary analysis of the SMC Application, the WQB determined that the proposed expansion would constitute a new or enlarged source of pollution and was therefore subject to Montana's nondegradation rules (ARM 16.20.701 et seq.). Degradation is defined as the increase in concentration of certain regulated substances above ambient (background) levels and may only be allowed by the BHES based on necessary social and economic concerns (75-5-303(1), MCA). Degradation is applied differently for surface and groundwater.

To achieve the proposed rate of production, SMC would have to double the annual amount of explosive compounds used underground. The increased usage of explosives would increase the load (mass per time) of nitrogen compounds and other constituents, and may increase the concentration (mass per volume) of nitrogen compounds in the adit water. Therefore, SMC was required to submit a petition for change of ambient water quality. The petition is considered part of the company's proposal.

Nondegradation applies to toxic and deleterious substances, and certain other substances, in surface water (ARM 16.20.701). Montana has adopted EPA's "Gold Book," EPA, 1986, which contains numerical standards for toxic and deleterious substances. In groundwater, nondegradation

applies to any parameter for which there is a Maximum Contaminant Level (ARM 16.20.1003(4)) or any pollutant that may adversely affect a beneficial use (ARM 16.20.1011). Presently, both nitrate and certain metals listed in the Gold Book are subject to the nondegradation rules.

Nondegradation applies to surface and groundwater outside of a mixing zone [ARM 16.20.701(1)]. Groundwater within the SMC property boundary is considered the mixing zone [ARM 16.20.1001(6)]. For surface water, a mixing zone is the area in which effluent and receiving water mix and is characteristically different from the receiving water [ARM 16.20.603(12)].

An MPDES permit was issued in 1979 for discharge of adit water from the Minneapolis Adit to the Stillwater River. Effluent limitations for metals were based on ambient levels (nondegradation) but nitrate was not subject to nondegradation rules at that time. Based on ecological concerns, total nitrogen was specified in the permit not to exceed 1 mg/L at the lower monitoring site.

SMC has never discharged to the Stillwater River under the terms of the MPDES permit. The primary means of disposing of excess adit water is to land apply (irrigate) or to percolate after conventional treatment. Under the groundwater rules, facilities with operating permits issued under the Metal Mine Reclamation Act are excluded from the permitting requirements of groundwater rules [ARM 16.20.1012(1)(m)]. SMC has operated under an operating permit since 1986. However, nondegradation, as well as all other water quality standards, apply to the SMC operation and are administered by both DSL and the WQB.

The levels of nitrate, TDS and metals, at the date SMC submitted the petition are used in Chapter 3 for the purpose of establishing existing concentrations. For the purpose of analyzing the company's proposal in Chapter 4, the no-action alternative is evaluated based on the existing water quality plus the currently permitted discharge.

The three options presented in Alternative 4 compare the full range of choices available to the Forest Service, DSL and the BHES regarding water quality. Alternative 5 includes agency modifications to the proposed action and contains additional water quality monitoring and mitigation measures. The decision to be made by the BHES would be to grant or deny the petition, with or without conditions. The Forest Service and DSL would select a water treatment option reflecting the level of existing water quality and conditions specified by the BHES. The selected option would then be incorporated with the other Alternatives (1, 2, 3 ,or 5). The actual sequencing of decisions may vary because of statutory timeframes, that is, DSL or Forest Service decisions may be made before the BHES decision.

### 2.5.1 No Action - 4a

Under this alternative SMC would continue to mine at 1,000 tpd. Present levels of discharge and contaminants would not be exceeded. The present system of treating and disposing of adit water would be maintained. Since no new or enlarged source of pollution would exist, SMC would not be subject to Montana's nondegradation rules other than those presently in effect for metals in the MPDES permit. The MPDES permit would be renewed based on the current effluent limitations.

Presently, SMC applies conventional treatment to adit water before land applying or routing the effluent to percolation ponds. Conventional treatment involves the removal of suspended solids and associated metals but is not effective for removal of nutrients. The existing treatment is discussed in this section but would apply to options 4b and 4c.

Clarification

The sediment laden water from the adits reports to a 30-foot diameter conical steel tank and is directed downward and outward. The heavier solid particles migrate downward and are drawn out the bottom through the under-flow pump. The process is facilitated by the use of a chemical flocculent. Overflow, or clarified water, is collected at the surface along the perimeter of the tank. The settled material, or underflow, is slurried to the lined tailings impoundment.

The mill and tailings impoundment are zero discharge facilities. That is, all water is 100 percent contained and recycled in the milling process. When necessary, adit water is directed to the mill circuit as make-up water.

### 2.5.2 Company's Proposal - 4b

The proposed action is described fully in Section 2.3. This alternative evaluates granting of the petition at the levels proposed by SMC (Section 2.3.20). However, BHES may grant the petition at levels less than the requested amount.

The BHES may grant a request for degradation of ambient water quality if it is demonstrated that beneficial uses would not be adversely impacted and the change is justified based on social and economic development. Further, the Water Quality Act requires any source of pollution subject to the nondegradation provisions to provide the degree of treatment necessary to maintain the existing water quality. Both state and federal regulations have been promulgated describing treatment control technologies for surface water discharges. The treatment proposed by SMC is to maintain the present level of treatment described in Alternative 4a.

If the petition were granted, the effluent limitations in SMC's MPDES permit would be renewed based on the ambient concentrations requested in the petition and approved by the BHES. Similarly, groundwater concentrations would be maintained at the level requested in the petition and approved by the Board.

### 2.5.3 Advanced Water Treatments - 4c

Advanced water treatment of adit water would allow the company to expand production to 2,000 tpd without degradation of state water. This alternative evaluates denial of SMC's Petition for Modification of Ambient Waters (SMC, 1991a). Conventional treatment is not effective for the removal of nutrients and dissolved metals and therefore consideration of advanced treatment is warranted.

Montana's nondegradation rules require alternatives to the proposed action that result in less or no degradation. In the petition, SMC proposed three advanced treatment options - reverse osmosis, ion exchange, and forced evaporation - which fulfills this requirement. These options, as well as others, would be available to SMC if the BHES denied SMC's petition.

In evaluating these advanced treatment options, it is not the agencies' intent to specify operating policy and procedures to SMC, but rather to inform the BHES and the public that alternative treatment techniques are available. If the petition were denied, SMC would be required to submit a plan to the agencies that would maintain water quality at ambient levels before approval to expand to 2,000 tpd were granted. This plan may, or may not, include advanced treatment of some, or all, of the adit water. SMC would be required to maintain the existing load (mass per time) of

nutrients and metals. Concentration (mass per volume) may increase or decrease depending on the volume of water encountered during operation.

Reverse Osmosis

Reverse osmosis produces a relatively clean effluent by concentrating dissolved substances through the use of semi-permeable membranes and high pressure. The concentrate would require additional treatment, such as forced evaporation, before disposal. This technology would also require pretreatment for the removal of suspended solids to prevent fouling of the membrane. Table 2.5-1 compares the treatment efficiencies, energy consumption and estimated costs.

Ion Exchange

Ion exchange utilizes a series of cation and anion exchange resins which selectively remove nitrate, dissolved solids and metals. This process is similar to water softening units commonly used on residential water supplies. However, a larger scale facility would be required to treat the SMC adit water. Backwashing of resins would produce highly concentrated brine which would require disposal. Ion exchange does not remove all components of the waste stream and therefore a petition would likely still be required. Table 2.5-1 compares treatment efficiencies, energy consumption, and estimated costs.

Forced Evaporation

A forced evaporation system would basically distill the effluent producing clean water and leaving behind for disposal, a concentrated brine or solid product. Table 2.5-1 compares treatment efficiencies, energy consumption, and estimated costs.

## 2.6 Proposed Action with Modifications - Alternative 5

The agencies have reviewed SMC's proposal and determined potential environmental consequences (see Chapter 4). Alternative 5 was developed to mitigate certain adverse impacts of SMC's proposed plan, and provides specific requirements to be added to SMC's proposed action described in section 2.3. Alternative 5 also includes additional monitoring which is intended to monitor the effectiveness of the proposed mitigation and validate the analytic assumptions and predictions developed by the agencies. This option could be selected in combination with any ambient level selected (4b or 4c), or in combination with Alternatives 2 or 3.

### 2.6.1 Water Resources

1. Modified Water Resources Monitoring Plan

SMC presently maintains a fixed station monitoring program with annual submittal of results to the agencies. SMC would be required to use lower detection limits, where appropriate and achievable, for cadmium, copper, lead, manganese, mercury, nickel and zinc for surface and groundwater monitoring. The detection limits currently being used are adequate for detecting exceedances of Maximum Contaminate Levels (MCL) but may not be adequate for detecting trends which may occur at much lower levels.

Table 2.5-1 Comparison of Conventional and Advanced Water Treatment Options

| Treatment Alternative | Treatment Category C-conventional A-advanced | Components | | | Removal Efficiency (%) or Final Concentration (REFC) | | | | | Costs (millions of Dollars)[1] | | Total Energy Requirements |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sand Filter | Forced Evaporation | Brine By-Product | Suspended Solids | Dissolved Solids | Ammonia | Nitrate | Metals | Initial | Annual O & M | kWh/day |
| Clarifier[2] | C | optional | -- | No | 60-99% | 0 | 0 | 0 | 50-99% | 0.50 | 0.05 | 821 |
| LAD or[2] Percolation | C | -- | -- | No | +99% | 20% | 10-100% | 40-60% | 90-99% | 0.137 | <0.001 | --- |
| Reverse[3] Osmosis | A | Yes | Yes | Yes | -- | 90% | 97% | 1.0 mg/L | 90% | 13.1 | 0.67 | 1,800 |
| Ion[4] Exchange | A | Yes | Yes | Yes | -- | <5% | <6.0 | <1.0 mg/L | 90% | 3.1 | 0.18 | 3,124 |
| Forced[5] Evaporation | A | No | -- | Yes | -- | <2 to 10 mg/L | 0-90% | >99% | 99% | 9.5 | 0.666 | 80,000 |

1. Source: Clarifiers and LAD costs provided by SMC (Gilbert, 1991) other costs from SMC, 1991b.
2. REFC based on observed data at SMC.
3. REFC based on SMC, 1991b and MDSL and USFS, 1990.
4. REFC based on MDSL and USFS, 1990, and May 22, 1989 Federal Register.
5. REFC based on USFS et al., 1991.
6. Requires use of ammonia-specific resins; REFC not evaluated

The current monitoring plan uses EPA approved analytical procedures. SMC would be required to maintain use of approved methods but validate the lower detection limits using the Method Detection Limit (40 CFR Part 136, Appendix 1B).

The present monitoring plan would be modified to sample the SVR (Stillwater Valley Ranch) monitoring wells (MW 12A, 13A, 14A and 15A) monthly during the period of the year in which they are the primary method of disposal. This additional sampling would be limited to nitrite plus nitrate, ammonia, and total dissolved solids (TDS). Also, SMC-2 and 10, and one additional point downstream of SMC-10 would be monitored for these same parameters. SMC-10 would be maintained as a point of compliance unless it was affirmatively demonstrated by the agencies that increases below this point were attributable to SMC.

2. Additional Groundwater Monitoring

Groundwater to the north of the SMC permit boundary, on the west side of the Stillwater River, is not adequately monitored by the present system of monitoring wells. The present and potential beneficial uses of this water include domestic consumption. Based on monitoring of the existing west side wells, nitrate levels are currently elevated in this vicinity. Test data from MW-9 and MW-11 indicate significant dilution, but projections beyond this point are not reliable. Additional monitoring would also be designed to address the impacts of the existing and/or enlarged west side drain field. Predictions of phosphorus and nitrogen loading could then be substantiated.

Similarly, groundwater northeast of the SMC property boundary is not adequately monitored by MW-15A, MW-13A and MW-12A. Existing data indicates that groundwater flows from the percolation ponds to the north and east. The degree of mixing is unknown.

SMC would be required to submit a plan to install additional monitoring wells for agency approval. The monitoring wells would be located near the property boundary to assess off-site impacts and would be used as a point of compliance for groundwater monitoring. Upon completion of additional wells and collection of data, SMC would be required to submit an updated groundwater map including the east and west side. The frequency and/or number of parameters analyzed at existing sites may be reduced if, after consultation with the agencies, these sites are considered redundant.

If groundwater monitoring determined that ambient groundwater concentrations were being exceeded, SMC would be required to treat its discharge, as necessary, to achieve the appropriate concentration. Ambient concentrations would be determined by the BHES. Based on monitoring results, the agencies would notify SMC that ambient levels were being exceeded. SMC would be required to begin treatment within 45 days after written notification from the agencies. If treatment were not effectively reducing the concentration of the parameter of concern, SMC would be required to reduce or terminate operations until compliance could be achieved.

3. LAD Identification and monitoring.

Land Application Disposal (LAD) through spray irrigation is a proven and valuable method for reduction of nutrients and metals. However, this practice should be monitored to document the continued capability of the soil to maintain this level of removal and any measurable build up in trace elements.

SMC would be required to submit to the agencies an updated map delineating LAD areas. This map would include soil types based on the most recent soil survey information. Each soil type would be sampled on two locations annually for soil pH, cation exchange capacity (CEC) and trace elements. Samples would be taken at 0 to 6 inches, 6 to 12 inches and greater than 12 inches. SMC would be required to maintain soil pH greater than 6.5. Land application off the SMC permit boundary would be subject to similar requirements.

4. Modification of Emergency Spill Containment Procedures

SMC's Emergency Spill Containment Procedures (Application - Appendix B) would be modified to include notifying the Montana Hazardous Materials Emergency Response System [(406)444-6911, ARM 16.20.1025(2)] immediately if pipelines crossing the Stillwater River failed and any material entered the river. If no material entered the river, SMC would still be required to notify DSL within 48 hours. In either case, SMC would be required to submit within 30 days a written report describing the cause and extent of the spill and remedial actions that were implemented.

5. Biological Monitoring Program

Because nitrate has been identified by the agencies as a possible concern, SMC would be required to develop a program to sample periphyton for agency approval. This program should be designed to assess existing conditions relative to pre-permitting baseline studies. Natural and artificial substrates would be included to assess algal biomass and community structure. Agency approval of the plan would be required before expansion was permitted.

6. Mine Water Discharge - Reclamation

Maintenance of the percolation ponds would be necessary until water quality parameters are met. Once the water quality reaches acceptable limits of quality and quantity, the pond can be breached and a channel constructed to allow the flow from the pond to reach a natural drainage course. For bonding purposes, SMC must submit a plan for perpetual pond maintenance, and a channel plan detailing how the water would be routed to natural drainages.

2.6.2 Tailing Impoundment Reclamation/Revegetation

Reclamation of the tailing impoundment surface and embankment would be difficult (see Chapter 4). Modifications to the proposed action are needed to 1) maintain embankment stability; 2) minimize loss of biological diversity by increasing soil replacement depths on the embankment slope and impoundment surface and limiting use of rock armor on the embankment face; 3) limit visual impacts by enhancing reclamation on the embankment face; and 4) maintain the ability to use heavy equipment on the reclaimed embankment slopes. A specific plan addressing these issues and reclamation of the impoundment must be submitted by SMC for agency approval by January 1, 1993. Mitigations to be part of the plan include:

1) Maintainence of approved slope stability factors of safety;

2) A detailed embankment slope reclamation plan is needed using a mosaic of rock armor placed asymmetrically across the slope to break slope length and increase soil to rock ratios. Some rock armor is needed to reduce soil loss to erosion. Soil loss calculations indicate slope length must be reduced to 50 feet or less. Deeper soil replacement depths would enhance revegetation success. Define the depth of glacial

till or alluvium needed for a subsoil layer to enhance revegetation success and achieve comparable stability and utility with the pre-disturbance soils in the area. Use of till and/or alluvium rather than waste rock would minimize the potential for piping of the replaced topsoil into a waste rock subsoil layer. Soil loss calculations indicate the need for replacement soils to have at least 50 percent coarse fragments to reduce soil loss to acceptable levels. Vegetation selected should be based on biological diversity and visual screening ability to help break the long linear lines of the embankment crest.

The current approved reclamation plan for the tailing surface may be optimistic especially concerning the amount and rate of tailing settlement and the degree of impoundment consolidation at closure. The consequences of underestimating settlement could include an inability to sustain the required reclamation gradient, subsequent precipitation recharge and saturation of the tailing mass and cap materials, and vegetation failure. The following procedures would be required at closure to provide definitive design criteria for reclamation:

Conduct tests of the in-place tailing, at sufficient grid spacing and depth, to define the range of impounded tailing materials properties.

From field testing, determine the degree of consolidation and settlement, including 1) estimate the amount of capping settlement that may result from pore pressure dissipation and primary consolidation, 2) reclamation cap placement and surcharge consolidation, and 3) long-term secondary consolidation.

Estimate the depths and volumes of reclamation cap fill that will be required to achieve necessary post-settlement gradients.

Address the amount of alluvium and/or glacial till needed as subsoil to increase replacement soil depths to levels found in soils that existed in the area before mining.

Provide a plan to test and verify the lack of acid producing potential in the tailing mass over the entire mine life.

### 2.6.3 Waste Rock

A plan for more detailed monitoring of waste-rock types and volumes would be developed by SMC and approved by the agencies. The plan should include details of static and kinetic testing to be conducted in case waste rock is encountered that falls in the range of -20 to +20 tons of lime needed to neutralize 1,000 tons of waste rock. Particular attention would be given to waste rock from faults and lithologic contact zones.

### 2.6.4 Soils

Reevaluation of soil salvage in all disturbed areas is needed because of the change in standards since 1985. The use of soils with less than 1 percent organic matter and with coarse fragment contents of 50 to 75 percent as subsoils under the salvaged topsoil already stockpiled at the

mine can enhance reclamation success to comparable stability and utility in the area. Inspections would be conducted by the agencies during soil salvage operations.

### 2.6.5 Wildlife

Habitat improvement would be required to replace acreage lost to new disturbance.

### 2.6.6 Aesthetics

Proper visual quality mitigation measures for this project involve the establishment of a natural variety of vegetation and land form to the extent possible on the tailings embankment, the interruption of the flat line formed by the top of the dam, and the screening of the administrative area and parking lot from the most common viewpoints.

The character of the surrounding landscape relates more readily to steep slopes than horizontal planes so blending the embankment into the area would not be as difficult as disrupting this hard line imposed by the dam crest. The methods for breaking this line and adding variety to the slope surface, however, are the same and differ only in where they are applied. These recommended visual quality mitigation measures include the use of boulders, large and small native shrubs, and large and small native tree specimens. Wind scouring will make establishment of large trees difficult.

Boulders used singly or in groups relieve the monotony of an otherwise smooth slope and relate strongly to the character of the surrounding environment. These large, locally obtained rocks can be placed and partially buried across the embankment at irregular intervals. Used judiciously and in conjunction with plant material, they can also be the basis for disguising the top of the dam and even the parking lot.

The use of various sizes of native trees and shrubs is essential in mitigating both short and long-term objectives. Random massings of trees, shrubs, rocks and combinations of the three will help achieve objectives for the slope of the embankment as viewed from the valley highway and Cathedral Ranch. Use of these plant materals will not meet foreground requirements in the short term but will greatly reduce the time it takes to eventually achieve the Retention of Visual Quality Objectives (VQO) over the life of the mining operation. In addition, specimens of large native conifers placed around the parking area would partially screen both the cars and buildings from views from the valley, help block machine noise, and reduce glare from night lighting.

### 2.6.7 Traffic

Although the 3.0 passenger/vehicle mitigation will remain, two changes would be implemented. Employees living within 10 miles of the mine would be exempt, and data collection would only be required in March and September.

## 2.7 Other Related Development Activities

Within the general project area there are other activities occurring currently or in the future which should be considered due to potential additional cumulative environmental impacts. In other words some activities may directly contribute either positive or negative environmental impacts which, when considered in conjunction with impacts created by implementation of SMC's 2,000-tpd

proposed amendment, lessen or increase the overall impact upon the quality of the human environment.

The purpose of this section is to identify the related development activities which need to be considered for cumulative impacts, and to provide the rationale as to why those activities are related.

The basis of this assessment of related development activities lies within the recently completed Stillwater Complex Integrated Resource Analysis (IRA) prepared by the Beartooth District of the CNF and the Big Timber District of the GNF. The IRA is an analysis of a geographic area, know as the Stillwater Complex, for the purpose of implementing the Custer and Gallatin National Forest Plans. The IRA includes a discussion on how projects were assessed using a "Reasonable and Foreseeable" development scenario. The area in question consists of approximately 193,243 acres in south-central Montana. The study area is bordered on the south by the Absaroka-Beartooth Wilderness. The IRA is available for review at either the Beartooth Ranger District in Red Lodge, or the Big Timber Ranger District at Big Timber.

The location of the proposed 2,000-tpd amendment is within the boundary of the Stillwater IRA and therefore the document was used as a guide to determine and assess other development activities. As a means of determining which activities or potential development within the complex should be evaluated a review was conducted of all Projects of Concern identified in the IRA. Projects of Concern were identified by applying the following four criteria:

1. Projects which may have impact in terms of;
   * Knowledge of issues and concerns
   * Past experience with similar projects
   * Overall consequences, and therefore the preparation of either an environmental assessment or environmental impact statement
2. Projects causing earth disturbance
3. Projects having major issues or concerns
4. Projects required by laws, regulations, or direction to be analyzed, such as those having an effect on roadless classification or threatened, endangered, or sensitive species.

Each Project of Concern was evaluated to determine if it had environmental consequences related to SMC's 2,000-tpd proposal in terms of geographical impact area. An initial list of related development activities was prepared by reviewing those Projects of Concern which are or would occur in habitat used by wildlife that could be impacted by SMC's proposed action. Wildlife was selected as an "indicator" resource because of the wide ranging migration routes and range for species such as elk and deer. In other words, more Projects of Concern will be evaluated for impacts to wildlife than for any other resource because of the potential impacts for such a large geographical area. The following subsections identify Projects of Concern that may impact wildlife and other resources that could also be affected by the SMC proposal. A more detailed description of each Project of Concern may be found in the Stillwater IRA. This document is available for public viewing at either the CNF Supervisor's office, or the Beartooth Ranger District office. Most environmental resources need to consider a much smaller impact area than wildlife; for instance, concerns about cumulative effects to surface and groundwaters are limited to development activities within the Stillwater River Drainage. Therefore, wildlife is by far the most prevalent resource of concern for the following projects.

In order to track the duration of proposed project impacts the following codes will appear at the end of each project description. This information is helpful in assessing when projects will impact surrounding resources, and when the effects of these projects will subside.

| | |
|---|---|
| PD | Project Duration |
| PI | Project Implementation |
| PR | Project Reclamation |
| NEPA | Year of NEPA Documentation |

The following projects considered for cumulative effects evaluations will be listed under the resource which would most likely be impacted due to implementation of that project. A single project may appear under more that one resource category if more than one potential cumulative effect has been identified.

### 2.7.1 Projects of Concern Evaluated (CNF)

The following projects are expected to have some degree of cumulative effects within the project area, when considered in combination with SMC's 2,000-tpd proposal.

#### Wildlife

(Rg 106) Horseman Flat Range Improvement Construct 0.75 mile of livestock water pipeline and 0.5 mile of pasture division fence in Horseman Flat allotment in the N½ Sec. 8 T5S, R15E. (PD:1991-1992; NEPA:1991; PI:1992; PR:1992) This project is included due to potential forage and cover impacts. This project is planned to occur adjacent to the mining complex.

(Rg 107) Horseman Flat Conifer Treatment Treat 200 acres of conifer encroachment in Horseman Flat allotment, through prescribed fire, post and pole sale or firewood collection. Sec. 9 T5S, R15E. (PD:1991-1992; NEPA:1992; PI:1992; PR:NA) This project will affect the amount and distribution of wildlife and domestic livestock use by providing additional forage for these animals.

(M104) Chrome Corporation of America-Mountain View/Mouat Mine Project. Continued chrome ore exploration and evaluation. Project disturbance is approximately 0.5 acre per year, therefore, by close of the project a little less than 3 acres will be affected. (PD:1990-1993; NEPA:On-going per yearly plan of operations submittal; PI:1990; PR:On-going). The area involved in this project serves as occasional elk habitat. This project is not expected to contribute water related cumulative effects because no open water resources are located in the immediate vicinity of the project area.

(M105) Stillwater PGM. Exploration and evaluation. Helicopter-supported core drilling operations. Surface disturbance of less than 0.1 acre per year. (PD:1990-1998; NEPA:On-going per year submittal of plan of operations; PI:1990; PR:On-going). Areas adjacent to the project area serve as moderate to high use elk summer range. Helicopters used to support drilling operations have the potential to displace elk if coordination and timing restrictions are not stipulated in the plan of operations approval.

(M106) Chrome Corporation of America-Crescent Creek/Iron Mountain Project. Continued chrome ore exploration and evaluation. Ground disturbance will be approximately 0.1 acre per year or a total of 1 acre through the life of the project. (PD:1990-1997: NEPA:On-going per submittal of yearly plan of operations; PI:1990; PR:On-going). Areas adjacent to the project area serve as moderate to high use elk summer range. Helicopters used to support this project have the potential to displace elk

if coordination and timing restriction are not stipulated in the plan of operations approval. This project represents small cumulative effect potential due to duration of the project.

## Recreation

(M105) Stillwater PGM. Exploration and evaluation. Helicopter-supported core drilling operations. Surface disturbance of less than 0.1 acre per year. (PD:1990-1998; NEPA:On-going per year submittal of plan of operations; PI:1990; PR:On-going). This project has potential to impact wilderness users and day hikers within the West Fork of the Stillwater River drainage due to helicopter support of the program.

(M106) Chrome Corporation of America-Crescent Creek/Iron Mountain Project. Continued chrome ore exploration and evaluation. Ground disturbance will be approximately 0.1 acre per year, or a total of 1 acre through the life of the project. (PD:1990-1997: NEPA:On-going per submittal of yearly plan of operations; PI:1990; PR:On-going). This project has the potential to impact wilderness users and day hikers within the West Fork of the Stillwater River drainage due to helicopter support.

(Rc102) Road Access to Limestone Butte/Bad Canyon Area Road access is needed to tie in with the existing trail system at the south end of the management area. The preferred route would be north of Limestone Butte. This option may not be feasible. The second access option is in the Robinson Draw area. This option is more likely and would also allow for tie-in with the trails system. Trail construction is estimated at $15,000. (PD:1992-1994; NEPA:1993; PI:1993; PR:None) This project will create additional recreational opportunities, thus preventing overuse or crowding in current recreational facilities or areas.

(Rc103) Johnson Draw Trail. Reconstruction of the Johnson Draw trail to provide loop opportunities for hikers, horse riders, and bicycles. This would not take place until Rc102 is accomplished and at an estimated price of $15,000. (PD:1993-1995; NEPA:1994; PI:1994; PR:None) This project is included for the same reason as Rc102.

(Rc104) Stillwater Overlook Development of a trail and overlook in the area of Old Nye Picnic area in 1993. This will create day-hiking opportunities and access to Horseman Flats Lake for fishing (Est. cost $15,000). (PD:1992-1994; NEPA:1992; PI:1993; PR:None) This project is included for the same reasons as Rc102, and Rc103.

(Rc105) Trailhead Parking at Lodgepole Road and Lodgepole/Dead Indian Creek Trails If public access is acquired on the Lodgepole Road, a trailhead parking facility will be needed at the junction of the Lodgepole Road and the Lodgepole and Dead Indian Creek trail systems. Access and trailhead facilities are targeted for 1993 at a cost of $10,000. (PD:1993-1997; NEPA:1996; PI:1996; PR:None) This project is included for the same reasons as Rc102, Rc103, and Rc104.

(Rc106) Trailhead and Washburn Trail Reconstruction Improvements to the road through Meyers Creek Station, development of a dispersed camping/trailhead facility, and reroute of the Washburn trail around the Washburn homestead. Target year to acquire the right of way and construct the trailhead is 1994. The estimated cost is $35,000. (PD:1994-1996; NEPA:1994-1995; PI:1997; PR:None) This project is included for the same reasons as Rc102, Rc103, Rc104 and Rc105.

(Rc107) Pass Creek Trail Locate the public access right of way through the private land and reroute the trail as needed for safety reasons. This will also involve reconstruction of the remainder of the

trail. Estimated cost is $6000. (PD:1993-1997; NEPA:1993; PI:1997; PR:None) This project is evaluated for the same reasons as Rc102, Rc103, Rc104 and Rc105.

(Rc108) Initial Creek Campground The Initial Creek drainage does not allow for dispersed recreation opportunities due to the limited public land in the drainage. Use is currently concentrated at the end of the West Fork Stillwater River drainage. Plans are for construction of a 20-30 unit campground. The cost and estimated timeframe is unknown at this time. (PD:1997-1999; NEPA:1997; PI:1998; PR:1998-1999 if needed) This project is evaluated for the same reasons as stated in Rc102, Rc103, Rc104, Rc105, and Rc107.

(Rc109) Off Road Vehicle Area. Development of a trail system for both summer use (motorcycles) and winter use (snowmobiles) which will provide loop trails and trailhead parking. As preliminary planning has not yet begun, estimated development schedule is 1996 at an unknown cost. (PD:1994-1997; NEPA:1995; PI:1996-1997; PR: None) This project will create additional recreational opportunities, thus preventing overuse or crowding in current recreational facilities or areas.

(Rc110) Trailhead and Reroute of Benbow Trail #51. This is a popular access route to the Stillwater Plateau for hunting, fishing, and views of the Great Plains. This trail will also provide access to Mt. Hague and Mt. Wood. Estimated construction will take place in 1996 at a cost of $20,000. (PD:1994-1996; NEPA:1995; PI:1996; PR:None). This project is evaluated for the same reasons as Rc102, Rc103, Rc104, Rc105, Rc107, and Rc108.

(Rc111) Woodbine Campground Reconstruction Planning is underway for the modernization and increased capacity of Woodbine Campground. Watershed concerns will be addressed in this project through the paving of roads and spurs. The estimated cost for the campground construction work is $210,000. Additional cost of road improvement and trailhead construction (ref. Rc112) is $350,000. This major project is planned for 1995. NOTE: The State plans to reconstruct FAS419 from FAP78 to the Stillwater Mine, and recreation use will significantly increase with a wide two-lane paved road providing access to the Woodbine area. (PD:1991-1996; NEPA:1992; PI:1995; PR:1996) This project would increase the quantity of recreational opportunities within the Stillwater River drainage.

(Rc112) Construction of Woodbine Falls Trail Trailhead. This is the second-most utilized "trail" on the Beartooth District. The trail has been developed through use and needs construction to improve the safety and grade. As it is a high-visibility site, we need a trailhead with parking facilities separate from the campground. Work is to be done in conjunction with the campground work in 1995. (PD:1991-1996; NEPA:1992; PI:1995; PR:None) This project would increase the quantity of recreational opportunities within the Stillwater River drainage.

## Water Resources

(Nx 101) Noxious Weed Control. Continue to treat on an annual basis all known infestations of noxious weeds within the Stillwater IRA. (27 acres) (PD:1991-2000; NEPA:each project; PI:1991; PR:NA) Weed control measures will be considered in the cumulative effects analysis due to the threat that introduction of chemicals poses to the groundwater.

(M101) Chrome Corporation of America Benbow Project. Continued chrome-ore exploration and evaluation that makes use of the access route from Dean to the Benbow Mine. Surface disturbance of 0.5 acre/year, or 2 acres total through duration of project. (PD:1990-1993; NEPA:1990; PI:1990;

PR:1992-1993). This project is evaluated due to possible effects to water resources. Within the project area there are numerous streams, riparian areas, and springs.

(Rc109) Off Road Vehicle Area. Development of a trail system for both summer use (motorcycles) and winter use (snowmobiles) which will provide loop trails and trailhead parking. As preliminary planning has not yet begun, estimated development schedule is 1996 at an unknown cost. (PD:1994-1997; NEPA:1995; PI:1996-1997; PR: None) This project would take place in areas previously disturbed by past minerals exploration and development. Numerous small streams exist within the project area.

Socioeconomics

(Rc102) Road Access to Limestone Butte/Bad Canyon Area Road access is needed to tie in with the existing trail system at the south end of the management area. The preferred route would be north of Limestone Butte. This option may not be feasible. The second access option is in the Robinson Draw area. This option is more likely and would also allow for tie-in with the trails system. Trail construction is estimated at $15,000. (PD:1992-1994; NEPA:1993; PI:1993; PR:None) Development of this road may increase the overall use in the area. Additionally, other resource values such as water and wildlife may be negatively affected due to implementation. However, development of this project may lessen the negative effects of overcrowding at currently-existing recreational areas or facilities.

(Rc103) Johnson Draw Trail. Reconstruction of the Johnson Draw trail to provide loop opportunities for hikers, horse riders, and bicycles. This would not take place until Rc102 is accomplished and at an estimated price of $15,000. (PD:1993-1995; NEPA:1994; PI:1994; PR:None) This project is included for the same reason as Rc102.

### 2.7.2 Projects of Concern Evaluated (GNF)

The following Projects of Concern listed within the GNF portion of the Stillwater IRA are evaluated for the purposes of cumulative-effects analysis. As previously stated, wildlife is the resource area which typically experiences the most noticeable impact due to cumulative effects. During the development of the East Boulder EIS, data collection and subsequent analysis indicated that the wildlife populations are expected to undergo very little adverse cumulative impacts due to the projected Reasonably Foreseeable Development forecast. Black bears were found to be an exception to this trend. Black bears apparently travel extensively between the East Boulder and the Stillwater River drainages (Stewart, personal communications). For the most part, wildlife which occurs on the GNF primarily utilizes habitat within the Boulder River drainage. The same wildlife habitat-use pattern is displayed within the Stillwater drainage.

The cumulative effects due to implementation of SMC's proposed action are sufficiently removed in both space and time from planned activities within the IRA analysis area of the GNF that no significant cumulative effects are expected. However, the following projects will be considered for the purpose of assessing cumulative effects.

Wildlife

The following is a summary of current minerals activity within the Stillwater Complex IRA area. These projects have potential for adverse cumulative impacts to recreation and wildlife. No

adverse cumulative effects are expected in regards to water resources since all of these projects take place in the Boulder River drainage.

(M1) East Boulder Platinum, Palladium Mine Plan of Operations: EIS East Boulder. (PD 1990-2015, NEPA 1991, PI 1991, PR ongoing 1995-2015) This project is being considered in terms of potential socioeconomic impacts as well as potential wildlife (black bear) impacts. When this project comes on line, there will be increased numbers of persons living or working within the analysis area. Additionally, those lands which will be impacted by this project serve as important black bear habitat. The same local black bear population seems to utilize habitat and travel between the Boulder and Stillwater River drainages during the spring, summer, and fall.

(M2) SPGMR Exploration On-going helicopter and ground-supported exploration program. (PD 1989-1991, NEPA 1988, PI 1989, PR incorporated into M1) This project has the potential to impact black bear, elk, and mule deer which utilize habitat between the Boulder and Stillwater Drainages.

(M5) Pegasus Explorational Drilling Independence. (unknown at this time, assume drilling program sometime between 1990-1995 with associated NEPA and reclamation to follow). This project would occupy seasonally important black bear habitat. Additionally, elk utilize the area in summer and fall.

(M6) Pathfinder Explorational Drilling Independence. (unknown at this time, assume drilling program sometime between 1990-1995 with associated NEPA and reclamation to follow). This project would occupy seasonally important black bear habitat. Additionally, elk utilize the area in summer and fall.

## Recreation

Recreationists apparently display the same use trends as wildlife in the project area. That is to say, people tend to utilize recreational opportunities within the area which they live. All the below-identified projects are expected to benefit the recreation resources in the analysis area. These projects are considered in the context of cumulative effects because it is expected that these recreational opportunities will be utilized by the increased mining-related population.

(Rc1) Campground reconstruction Redesign and reconstruct the East Boulder Campground. CE 1990. Cost: $29,000 CIP. Implement 1991.

(Rc2) Campground maintenance Provide heavy maintenance at West Boulder campground. Replace fire grates and picnic tables; improve vehicular access. Provide for handicapped access to restroom facilities. CE 1990. Cost: $15,000 CIP. Implementation 1991.

(Rc3) Trash dump and mining claim cleanup Inventory trash dumps and mining claims, especially in Placer Basin area. Clean up and pack out trash. Ongoing. No NEPA required.

(Rc4) High impact campsite restoration Provide restoration of high-impact campsites in the front and backcountry as needed. Some NEPA completed and ongoing. Cost: $25,000 in 1990. Excess timber sale receipt funding.

(Rc6) Picnic area construction Construct 2 small developed picnic areas.
One located off Iron Mountain Road and one in the Bridger Creeks. NEPA CE in 1990. Cost: $20,000. Implement 1992.

### 2.7.3 Projects of Concern Not Evaluated

The Stillwater IRA listed and considered 26 Projects of Concern for the purposes of cumulative-effects analysis on the Big Timber Ranger District. Nine of these have been considered for this project. Similarly, 31 Projects of Concern were listed and evaluated on the Beartooth Ranger District, 21 of these have been considered for the purposes of cumulative-effects analysis related to implementation of SMC's proposed action.

Projects of Concern not evaluated in this document do not contribute cumulative impacts within the project area due to the timing, administrative nature, or specific location of the proposed project. A description of these projects appear in Chapter 5 of the Stillwater IRA. This document is available to the reader upon request at either the CNF Supervisors Office, the Beartooth Ranger District, or the Big Timber Ranger District.

Two notable projects not evaluated in terms of cumulative effects for this proposed action are Chrome Corporation of America's (CCA) Mountain View project and International Platinum's (IP) Exploration program. Both of these projects were evaluated for possible cumulative effects in both the Stillwater Integrated Resource Analysis and the 1989 East Side Amendment EA/PER.

The rationale for not considering these projects for the purpose of cumulative effects assessment is that, at this time, neither project is reasonably foreseeable. During the summer of 1991, neither CCA nor IP filed Plans of Operations with the Beartooth Ranger District.

In the case of CCA, the market for chrome products is not favorable for profitable mining. This trend is not expected to be reversed in the foreseeable future. During 1991, CCA could not find a joint venture partner willing to share exploration cost at the Mountain View site. Therefore, the Beartooth District has directed CCA to implement final reclamation plans at the project site.

IP is no longer in business as a company conducting exploration projects. Therefore, the Beartooth Ranger District does not anticipate reactivation of a large-scale exploration program by this company.

# CHAPTER 3 - AFFECTED ENVIRONMENT

## 3.0 Introduction

An analysis of the potential environmental impacts of SMC's proposed 2,000-tpd expansion within the Stillwater River Valley necessitates an understanding of the current status of that environment. To facilitate this understanding, a review of current conditions has been conducted to address various environmental resources or disciplines. Together these topics encompass the social, economic, and natural settings which are part of the "affected environment" for this project. The material described has been guided by public issues identified through the scoping process and interdisciplinary field analysis.

The location of the proposed amendment to the current plan of operations is in the upper reaches of the Stillwater River Valley approximately 5 miles southwest of Nye, Montana. The surrounding area is mountainous, relatively sparsely populated, and noted for its scenic beauty and recreational opportunities such as hunting, hiking, fishing, and camping. The Absaroka-Beartooth Wilderness lies approximately 1.5 miles to the south of the project area; additionally, Yellowstone National Park lies approximately 25 miles to the south.

An important function of this environmental assessment is to evaluate alternatives developed to reduce or eliminate degradation of groundwater and surface waters in the vicinity of the mine. Montana groundwater pollution control for mining projects occurs through conditions contained in the operating permit. Discharges to groundwater and surface waters for this project would contain compounds such as iron and nitrates at concentrations greater than the existing water quality and would, therefore, require an exception under the Montana non-degradation rules. This environmental assessment will provide the analysis required by the BHES to make an informed decision whether to grant the exception or to require implementation of methods designed to prevent water degradation.

This section of the document describes only those parts of the environment that could be affected directly or indirectly by the proposed action. For the sake of brevity, those portions of the environment that will not be impacted by this project have not been discussed.

This section is tiered to both the original EIS (1985) for the Stillwater Project and the East Side EA/PER (1989).

## 3.1 Geology

The platinum group metals (PGM) that SMC extracts are found in the Stillwater Complex, a 1- to 5-mile-thick by 28-mile-long geologic formation consisting of layers of iron and magnesium-rich, generally dark-colored, igneous rocks. The platinum and palladium rich ore zone called the J-M Reef averages four feet in width and is located near the bottom of the tilted complex above the chromite-rich zones. The J-M Reef and some of the chromite beds can be traced for the full length of the exposed complex. The depth of these features is not known, but geophysical studies and outcrops of similar rocks to the north suggest that they could continue for several miles.

The Stillwater Complex also contains concentrations of chrome, copper, nickel, and iron minerals which have periodically drawn the interest of a variety of mining companies. Generally, the concentrations of these elements is not high enough to warrant commercial development considering current prices and technology, but the resources are significant and may be important for national security reasons. Chrome was mined during the two world wars from the Benbow and Mouat mines

in the Stillwater River valley, and the Gish Mine in Main Boulder River valley until the Department of Defense was able to secure the sea lanes to ensure the supply from South Africa, which remains our major source of chrome.

For complete details of the Stillwater Complex please read "Stillwater Complex, Special Publication 92," by the Montana Bureau of Mines and Geology, 1985. The Stillwater EIS (DSL/FS, 1985) also contains a thorough discussion.

### 3.1.1 Geotechnical

#### Subsidence

As discussed in the 1985 EIS written for the initial permit (Chapter IV, pages 2-3), crown pillar failure above underground workings could result in surface subsidence. With the advance of mining into crown pillars, high extraction ratios and subsequent mining-induced stress increases cause inequilibrium and resulting fracturing within the surrounding rock mass. Destressing through microfracturing can occur extensively into the rock mass surrounding underground openings and, in the proposed 50-foot crown pillars, destress fractures can be expected to intersect fractured, weathered rock that occurs naturally near the surface.

The degree of surface expression of subsidence is dependent on the load-bearing strength of the rock and the geometry and extent of mined areas. Convergence, or the tendency of underground openings to close over time as equilibrium is reestablished, is the physical cause of surface subsidence; convergence can be controlled and reduced by remnant sill and rib pillars within the mining plane, and to a limited extent by backfilled mine openings. Since provided information indicates that ore grade material is not consistent throughout the plane of the deposit, it is anticipated that adequate pillars will remain in place and substantially limit convergence. Further, backfilled stopes minimize the void available for failed crown pillar materials to fall into, and the tendency of fractured rock to swell relative to the in-place volume would choke off caving and prohibit mass subsidence.

Surface subsidence is expected to occur in areas where stoping advances to within 50 feet of the surface; however the extent of subsidence would likely not be visible to a casual observer and may only be detectable by instrumentation. The geomorphic effects of surface subsidence should be stable and inconsequential, though fractured crown pillars would create conduits for surface water recharge of groundwater flows.

Fractured crown pillars and minimal subsidence above backfilled voids results in a cone of depression and drawdown point for area groundwater. Groundwater flows increase through the pervious sandfill and mine openings, and corresponding recharge from surface flows causes a permanent change in the area groundwater and surface water systems. In areas where the fractured crown pillars intersect snowmelt saturation zones or are crossed by drainage courses, surface water transition to the altered groundwater system can involve significant volumes.

#### Seismicity

The project area is characterized as an area of low to moderate seismicity. Within historical times only one earthquake with a magnitude greater than 7.0 on the Richter scale has occurred within a 100-mile radius of the site. This earthquake in 1959 had its epicenter 72 miles southwest of the project area in the vicinity of Hebgen Lake. The quake, measuring 7.1, caused minor damage and

generated several rock falls within the Stillwater drainage (see also Stillwater Project EIS, Chapter III, pages 6-8).

The nearest fault known to be active in the area is the Emigrant Fault located in the Yellowstone River Valley, about 32 miles to the west. This fault has the potential to generate a large earthquake of up to 7.0. The tailing impoundment permitted for the original mine was constructed to withstand earth tremors of this magnitude.

Localized faulting is not believed to have the strike length or displacement of the active fault systems that were analyzed by SMC. It is improbable that movement along the local fault zones would generate ground vibration at the site that would exceed the average particle acceleration of 10 percent of gravity that has been used in the analyses. Peak particle accelerations of short duration may exceed the average particle acceleration used in the stability analyses, but are not considered to be as structurally damaging as sustained (or average) particle movement. Published information (Hunt, 1984) indicates that the project area has a 90 percent probability of not exceeding a peak particle acceleration of 20 percent of gravity in 50 years. Therefore, the selected seismic coefficient of an average particle acceleration of 10 percent of gravity is considered to be reasonable.

The dam itself is not subject to liquefaction by ground vibration, partly because it is constructed of material with a graded particle size distribution that is not conducive to pore pressure increases during vibration, but more importantly because the pond is lined and the dam and foundation are not designed to pass seepage (unlike water retention structures).

Failure of the dam by displacement would not be expected to have catastrophic consequences. Failure of the dam by displacement may result in the facility being structurally unsound for future use. Some ponded water could be released by total displacement failure of the dam, but the tailing mass would not be expected to flow.

Potential Geologic Hazards

The roads and adits in the permit area are constructed on Pleistocene landslide and glacial deposits up to 400 feet thick. This material was deposited under glacial conditions totally different from those which exist today and have been stable for thousands of years. These old deposits pose no threat of reactivation during the life of the mine. There is always a possibility of rock fall and small scale landslides within the Stillwater Valley and precautions have been taken for the adits constructed below potential slide areas to protect portals (see also the Stillwater Project EIS, Chapter III, pages 8-10).

Numerous avalanche tracks occur near the mine site. However, the permit area does not include any avalanche corridors.

## 3.2 Water Resources

### 3.2.1 Surface Water

Surface water features near the Stillwater Mine are dominated by the Stillwater River. The Stillwater River flows within one-quarter mile of the mine. All water that flows from the mine area drains into the Stillwater River. Most other drainages within the southeastern portion of the Beartooth Mountains also flow into the Stillwater River.

Flows in the river usually peak during June or July from snowmelt and increased spring precipitation. Roughly three-fourths of the annual runoff occurs in May, June, and July. At the U.S. Geological Survey's monitoring site near Nye, Montana, the maximum peak flow recorded was 6,400 cubic feet per second (cfs); the lowest flow recorded was 23 cfs, or less than 1 percent of the maximum flow. The upper Stillwater basin has a high variation in average annual precipitation rate (20 to 40 inches per year) and rough topography (maximum relief is 6,400 feet), which account for the wide range in water flows and high spring runoff.

Several small tributaries flow into the Stillwater River in the mine project area and are considered sub-alpine streams. These streams are, Verdigris Creek, Nye Creek, and Mountain View Creek.

Surface water quality within the Stillwater River Basin is generally good to excellent, reflecting the undeveloped state of the area. The Stillwater River is classified as a B-1 type by DHES, meaning the water is generally suitable after conventional water treatment for drinking, cooking, and food processing. The water may be used without further treatment for bathing; swimming; recreation; growth and propagation of trout fisheries and associated aquatic life, water fowl and furbearers; and agricultural and industrial supply.

Baseline and on-going operational monitoring has been conducted by SMC at the mine site since 1980. This data is supplemented by occasional monitoring by the agencies. Monitoring locations are depicted in Figure 3.2-1. Results from the SMC operational monitoring program for the Stillwater River, Mountain View and Nye Creek are summarized in Table 3.2-1[1].

The Stillwater River is low in total dissolved solids (TDS), has near neutral pH, and has generally low metals concentrations. Concentrations of dissolved solids are generally lowest during seasonal high flows and increase during the low flows in late fall and winter. TDS ranged from 18 mg/L on May 25, 1988 at SMC-2 to 98 mg/L at SMC-10 on November 21, 1991. TDS for the two tributaries are on average higher than the Stillwater but demonstrate similar annual variation.

Total nitrogen (nitrite, nitrate, ammonia and Kjeldahl) and total phosphorus (total and orthophosphate) concentration are also low reflecting the pristine quality of this environment. The highest nitrate concentration, 0.50 mg/L, in the Stillwater River was observed on December 20, 1989 at SMC 1A. The ratio of total nitrogen to total phosphorus indicate that phosphorus is the limiting factor for algal production. Measurements of nitrogen compounds at the upper monitoring site (SMC-1A) and below (SMC-2 and 10) indicate that the present mining operation has not increased the nitrogen concentration of the Stillwater River at these locations.

Cadmium, chromium, copper, iron, and zinc are occasionally found at detectable concentrations at most of the monitored sites (Table 3.2-1). Aluminum (<0.030 to .300 mg/L), manganese (<0.001 to 0.010 mg/L), and strontium (0.020 to 0.050 mg/L) are also common in the Stillwater drainage (Feltis and Litke, 1987). Surface water samples are analyzed as Total Recoverable

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[1]In calculating mean (average) concentrations, and in other numerical calculations for metal analyses, the analytical detection limit was used for values that were reported as being below detection limit. Only when all observations are below detection limits is the value reported as below detection limit ("<"). This procedure introduces a bias into arithmetic averages and other numeric calculations. Therefore, the detection limit and number of analyses using that detection limit are also reported to give the reader a point of reference to evaluate the reliability of the reported value.

Figure 3.2-1 Monitoring Site Locations

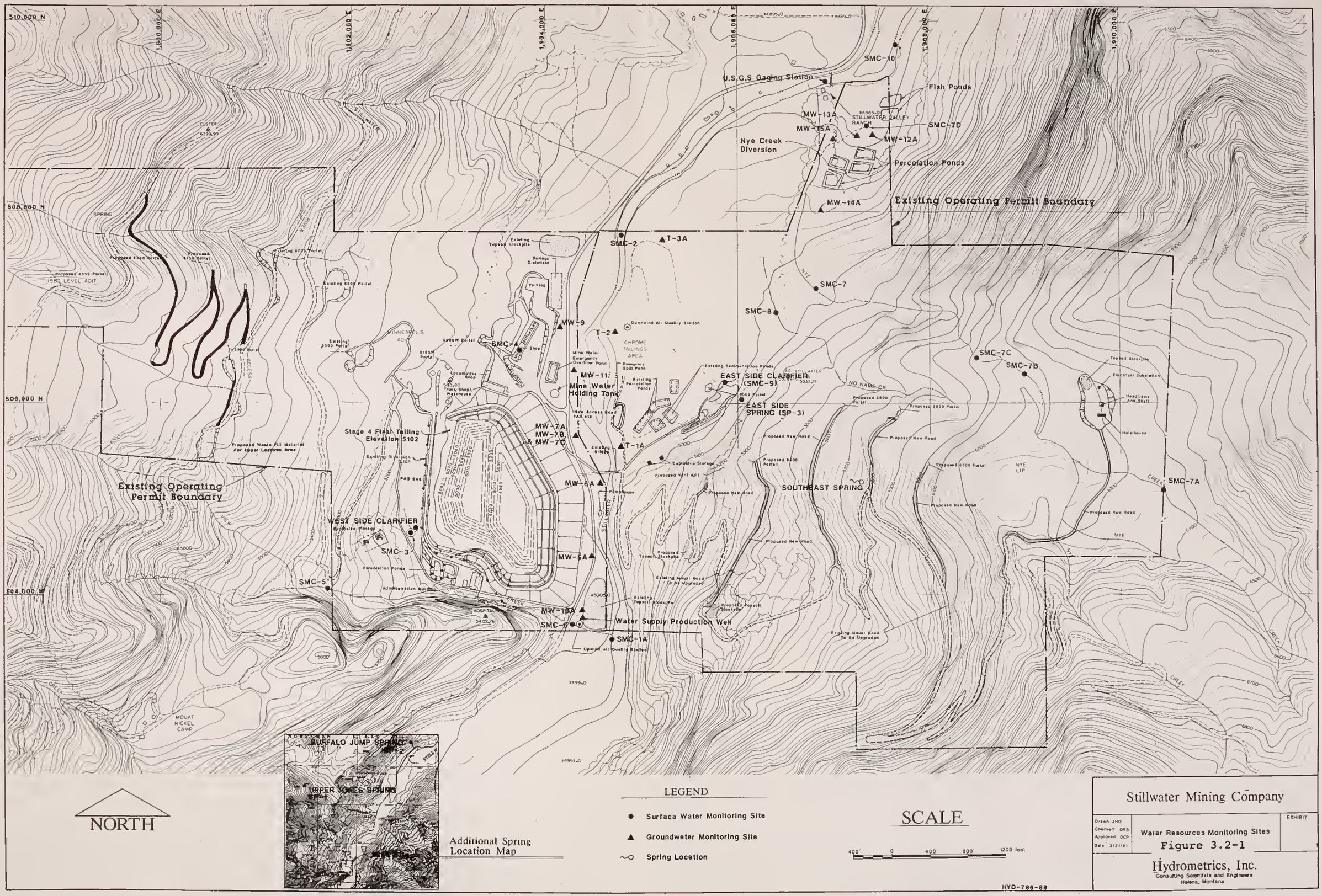
510,000 N
508,000 N
506,000 N
504,000 N
1,900,000 E
1,902,000 E
1,904,000 E
1,906,000 E
1,908,000 E
1,910,000 E
SMC-10
U.S.G.S Gaging Station
Fish Ponds
MW-13A
MW-15A
STILLWATER RANCH
SMC-7D
MW-12A
Nye Creek Diversion
Percolation Ponds
MW-14A
Existing Operating Permit Boundary
SMC-2
T-3A
SMC-7
SMC-8
MW-9
T-2
Downwind Air Quality Station
CHROME TAILINGS AREA
SMC-4
MW-11
Mine Water Holding Tank
EAST SIDE CLARIFIER (SMC-9)
EAST SIDE SPRING (SP-3)
SMC-7C
SMC-7B
Stage 4 Final Tailing Elevation 5102
MW-7A MW-7B & MW-7C
T-1A
MW-6A
SOUTHEAST SPRING
SMC-7A
WEST SIDE CLARIFIER
SMC-3
MW-5A
SMC-5
MW-10A
SMC-6
Water Supply Production Well
SMC-1A
Existing Operating Permit Boundary
MOUAT NICKEL CAMP
NORTH
BUFFALO JUMP SPRING
UPPER JONES SPRING
Additional Spring Location Map
LEGEND
Surface Water Monitoring Site
Groundwater Monitoring Site
Spring Location
SCALE
400' 0 400' 800' 1200 feet
Stillwater Mining Company
Drawn JHD
Checked DRS
Approved DCP
Date 3/21/91
Water Resources Monitoring Sites
Figure 3.2-1
EXHIBIT
Hydrometrics, Inc.
Consulting Scientists and Engineers
Helena, Montana
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Table 3.2-1 Surface Water Quality Data for Stillwater River (SMC-1A, 2 and 10), Nye Creek (SMC-7) and Mountain View Creek (SMC-6)

| | Location | | | | |
|---|---|---|---|---|---|
| Parameter | SMC-1A | SMC-2 | SMC-10 | SMC-7 | SMC-6 |
| Begin Date | May 1986 | May 1986 | November 1990 | May 1988 | March 1987 |
| End Date | June 1991 | June 1991 | June 1991 | January 1991 | January 1991 |
| Sample Size | 17 | 17 | 4 | 8 | 11 |
| pH (Standard Units) | 6.7 | 6.8 | 7.1 | 7.6 | 7.8 |
| Specific Conductance (μmhos/cm) | 50 | 50 | 82 | 121 | 231 |
| Total Dissolved Solids (mg/L) | 31 | 32 | 52 | 73 | 133 |
| **Major Cations (mg/L)** | | | | | |
| Calcium | 5 | 5 | 9 | 10 | 18 |
| Magnesium | 2 | 2 | 4 | 9 | 19 |
| Sodium | 1 | 1 | 2 | 2 | 4 |
| Potassium | <1 | <1 | 1 | <1 | <1 |
| **Major Anions (mg/L)** | | | | | |
| Bicarbonate | 22 | 22 | 43 | 71 | 144 |
| Sulfate | 5 | 6 | 8 | 6 | 9 |
| Chloride | 1 | 1 | 1 | 1 | 2 |
| Hardness | 21 | 20 | 39 | 61 | 123 |
| **Nutrients (mg/L)** | | | | | |
| $NO_2 + NO_3$ | 0.16 | 0.18 | 0.29 | 0.06 | 0.19 |
| Ammonia | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Kjeldahl Nitrogen | 0.2 | 0.5 | 0.5 | 0.1 | 0.1 |
| Total Phosphorus | 0.02 | 0.07 | 0.01 | 0.01 | 0.01 |
| **Total Recoverable Metals* (mg/L)** | | | | | |
| Cadmium (0.001) | 0.002 (8) | 0.003 (8) | <0.001 (4) | 0.001 (6) | <0.001 (6) |
| Chromium (0.02) | <0.02 (16) | <0.02 (16) | <0.02 (3) | <0.02 (8) | 0.04 (11) |
| Copper (0.01) | 0.01 (15) | 0.01 (16) | <0.01 (4) | <0.01 (8) | <0.01 (11) |
| Iron (0.01) | 0.26 (4) | 0.09 (4) | 0.11 (2) | | |
| Lead (0.01) | 0.01 (16) | <0.01 (11) | 0.01 (3) | <0.01 (6) | <0.01 (6) |
| Manganese (0.02) | <0.02 (5) | <0.02 (5) | <0.02 (2) | | |
| Nickel (0.03) | <0.03 (15) | <0.03 (11) | <0.03 (3) | <0.03 (8) | <0.08 (5) |
| Zinc (0.01) | 0.01 (17) | 0.01 (16) | 0.01 (4) | 0.01 (8) | 0.01 (11) |

Source: SMC, 1991b

*Parentheses indicate detection limit and sample size at the reported detection limit. See footnote on page 637

(unfiltered and field acidified) which includes the particulate material in the sample. Metals are generally associated with this particulate material and are not found at detectable amounts in the dissolved state.

Because of the concern for nondegradation, supplemental analyses for additional parameters and utilizing lower detection limits than used in routine monitoring were performed by SMC. These analyses indicate that arsenic, antimony, beryllium, mercury, selenium, silver, and thallium do not occur at detectable levels.

With the exception of cadmium and lead in the Stillwater River and possibly chromium in Mountain View Creek all metals are less than freshwater chronic or human health criteria. The freshwater criteria are 0.0003 mg/L for cadmium and 0.0004 mg/L for lead at a hardness of 20 mg/L (as $CaCO_3$). The freshwater criteria for hexavalent chromium are 0.011 mg/L and 0.055 mg/L for trivalent chromium. The analytical method utilized measures total chromium and since trivalent is much more common, it is likely that the standards for chromium are not being exceeded.

Iron, copper, and nickel sulfides, as well as chromite ($Cr_2O_4$) are well documented in the Stillwater Complex and would reasonably be expected to be elevated in this area. Other metals of concern, such as lead, cadmium, mercury and zinc are present in localized zones. The low solubility of these metals limits their concentration and they are usually only found in association with particulate material. Mining increases the concentration of metals in water that contacts mine workings. The chromium in Mountain View Creek is a result of an abandoned adit above the SMC permit boundary. No evidence indicates that present mining operations have increased the concentrations of metals in surface waters.

### 3.2.2 Groundwater

There are two major aquifers present in the Stillwater Valley near the mine site. These are the unconsolidated alluvial deposits of the Stillwater Valley and the fractured bedrock system.

Bedrock lies on both sides of the Stillwater River and beneath the surficial deposits that occupy the valley. Groundwater in the bedrock is mainly confined to openings such as joints, faults, and shear zones.

Recharge of the bedrock groundwater system probably occurs mostly at higher elevations, where snowmelt and rain infiltrate and percolate along joints, fractures, and bedrock discontinuities. Some recharge to the bedrock may occur via infiltration of groundwater from saturated alluvial or other unconsolidated deposits located along the margins of the Stillwater River.

Groundwater leaves the bedrock as (1) surface springs and (2) discharge to unconsolidated subsurface materials low in the valleys and draws of the region. Groundwater discharge from bedrock most likely contributes significantly to alluvial groundwater and possibly surface water systems of the Stillwater River. Seasonal variation in the volume of bedrock discharge, along with infiltrated surface runoff from snowmelt, contributes to the perennial character of the Stillwater River (SMC, 1984a).

The alluvium along the Stillwater River is the major source of groundwater in the valley. The general flow direction for the Stillwater River alluvial groundwater is downstream, or from the south and west to the north and east. The Stillwater alluvium is capable of producing more than several hundred gallons per minute on a sustained basis. At least 17 wells are known to produce water from the alluvial deposits in the upper Stillwater River Valley. Fifteen of these are used as domestic water supplies.

In addition to the alluvial deposits, an area on the east side of the mine site contains an additional unconsolidated deposit composed of old tailings from the previous Anaconda Chrome Mine. Three observation wells have been placed in the tailings pile and have been used to collect both flow and water-quality parameters. Transmissivities of the deposits were estimated to range from 650 to 11,165 gallons/day/ft. For a more in-depth review, please see the Stillwater Project EIS.

Eight monitoring wells are installed on the west side of the Stillwater River, three on the east side and four wells are installed in the vicinity of the Stillwater Valley Ranch (SVR) percolation ponds (Figure 3.2-1). SMC currently disposes of approximately 500 gpm of excess adit water through land application (flood and spray irrigation) during the growing season (approximately 6 months) and through percolation ponds located at the SVR during the remainder of the year. Other percolation ponds are used intermittently to hold excess water encountered during drilling, for maintenance and during power failures. During the growing season approximately 40 percent of the water is land applied to the west side and the remainder applied on the east side (Jim Richter, personal communication, 1991a).

Groundwater samples from the west side monitoring wells show the water quality is generally of good quality (Table 3.2-2). Area groundwater is classified as Class 1 (ARM 16.20.1002). This classification means groundwater is generally suitable for all beneficial uses with little or no treatment. Groundwater is a calcium bicarbonate or calcium-magnesium bicarbonate type. Total dissolved solids (TDS), sulfate, and nitrate concentrations generally increase in a downgradient direction. Metals are measured as dissolved (field filtered and acidified). Chromium, zinc and to a lesser extent cadmium are elevated in the downgradient wells (MW-11 and MW-9) relative to the upgradient well (MW-10).

Table 3.2-2 Groundwater Quality Data - Selected West Side Monitoring Wells

| | Location | | |
|---|---|---|---|
| Parameter | MW-10 | MW-11 | MW-9 |
| Begin Date | March 1987 | March 1987 | March 1987 |
| End Date | December 1990 | December 1990 | December 1990 |
| Sample Size | 14 | 15 | 14 |
| pH (Standard Units) | 7.2 | 7.4 | 7.3 |
| Specific Conductance ($\mu$mhos/cm) | 135 | 301 | 246 |
| Total Dissolved Solids (mg/L) | 84 | 179 | 149 |
| Major Cations (mg/L) | | | |
| Calcium | 11 | 22 | 19 |
| Magnesium | 8 | 21 | 18 |
| Sodium | 5 | 8 | 7 |
| Potassium | 2 | 2 | 2 |
| Major Anions (mg/L) | | | |
| Bicarbonate | 71 | 133 | 121 |
| Sulfate | 10 | 35 | 24 |
| Chloride | 3 | 6 | 5 |
| Hardness | 62 | 146 | 121 |
| Nutrients (mg/L) | | | |
| $NO_2$ + $NO_3$ | 0.22 | 2.13 | 1.13 |
| Ammonia | 0.1 | <0.1 | 0.1 |
| Kjeldahl Nitrogen | 0.1 | 0.2 | 0.1 |
| Total Phosphorus | | | |
| Dissolved Metals* (mg/L) | | | |
| Cadmium (0.001) | <0.001 (7) | <0.001 (7) | 0.001 (7) |
| Chromium (0.02) | <0.02 | 0.04 | 0.03 |
| Copper (0.01) | <0.01 | <0.01 | <0.01 |
| Lead (0.01) | <0.01 (7) | <0.01 (7) | <0.01 (7) |
| Nickel (0.03) | <0.03 | <0.03 | <0.03 |
| Zinc (0.01) | 0.01 | 0.02 | 0.03 |

Source: SMC, 1991b

* Parentheses indicates detection limit and sample size at the reported detection limit. See footnote on page 62.

Increasing levels of TDS, sulfate, nitrate and to a lesser extent, chromium and zinc, reflect the current practice of disposing of excess adit water through land application and percolation. Data from 1980-83 in the same vicinity (MW-5,6,7 & 8) indicate TDS concentrations of 95 to 183 mg/L, sulfate concentrations of 10 to 14 mg/L, and nitrate concentrations of 0.11 to 0.35 mg/L (SMC, 1984). Zinc concentrations appear to have decreased from a range of 0.02 to 0.26 mg/L to the current levels, and chromium remains within the range originally observed, from <0.02 to 0.05 mg/L.

The primary impact to the groundwater is in the vicinity of MW-11. Significant dilution occurs between MW-11 and MW-9, approximately 400 feet away. This dilution is probably a result of mixing with the groundwater and dilution from the Stillwater River. Average static water levels in the vicinity indicate that the Stillwater River is a losing stream in this section. Dilution probably continues to occur and concentrations of these parameters may be lower at the SMC permit boundary 1,000 feet downgradient. However, the lack of additional monitoring wells and the location of the drain field precludes accurate assessment of off-site impacts.

The nearest downgradient beneficial use is a domestic well (T5S, R15E, Sec. 16 DDD) located in the alluvial aquifer approximately 1,000 feet below the SMC permit boundary. Chemical data collected by SMC on this well indicated it is largely influenced by the Stillwater River and is not impacted by SMC operations. The concentration of TDS is 54 mg/L, sulfate is 10 mg/L and nitrate is 0.28 mg/L based on the average of two samples taken in 1989 and 1990 (SMC, 1991c). Moreover, the calcium to magnesium ratio indicates the source of this water is from surface water (2:1) and not groundwater (1:1). Cadmium, chromium, copper, lead and nickel were all below the analytical detection limit. Zinc was measured at the detection limit (0.01 mg/L).

Groundwater quality on the east side in the vicinity of the old chrome tailing are monitored with three monitoring wells (Table 3.2-3). Water quality is generally good and with increased concentrations of TDS, sulfate and nitrate similar to those observed on the west side. TDS and nitrate concentrations for the most recent period (1990-91) are 180 and 3.24 mg/L, respectively, compared to 46 and 0.18 mg/L, respectively, prior to land application. Despite the old chrome tailings in this vicinity metal concentrations are at or below detection limits and show no increase in concentration.

In the fall of 1990 SMC constructed four additional percolation ponds on the Stillwater Valley Ranch (SVR) (Amendment No. 007) to dispose of excess adit water during periods of the year when irrigation is not possible. These ponds were constructed in alluvial materials (interbedded gravel, sand and cobble) approximately 600 feet from the Stillwater River. Four additional monitoring wells were installed at this time. MW-14A was intended to be an upgradient control and MW-12A, MW-13A and MW-15A were installed as downgradient monitoring wells.

All adit discharge between March 1991 and May 1991 was directed to the SVR percolation ponds. Monitoring results for these wells before and after percolation are summarized in Table 3.2-4. Based on the TDS, sulfate and nitrate concentrations in MW-14A it is likely that this well is influenced by land application in the area to the south and west. TDS, sulfate and nitrate concentrations (average 254, 76 and 4.95 mg/L, respectively) in MW-12A and MW-13A increased much more than MW-15A (104, 13 and 0.053 mg/L, respectively) after percolation. Based on this chemical data, flow is directed in a north and easterly direction from the percolation ponds.

Metal concentrations are at, or below, detection limits in the SVR monitoring wells. No increase in concentration was observed after utilization of these ponds.

There are presently no downgradient domestic uses of groundwater on the east side before constriction of the valley approximately 0.5 miles downstream of the SVR percolation ponds. Surface ownership is either SMC or USFS. It is believed that significant mixing of groundwater occurs as a result of this constriction and the change of the Stillwater River from a losing stream to a gaining stream, at least during part of the year.

Table 3.2-3 Groundwater Quality Data - East Side Monitoring Wells

| Parameter | Location T-1A | T-2 | T-3A |
|---|---|---|---|
| Begin Date | March 1988 | March 1988 | March 1988 |
| End Date | January 1991 | January 1991 | January 1991 |
| Sample Size | 9 | 9 | 9 |
| pH (Standard Units) | 7.4 | 7.0 | 7.1 |
| Specific Conductance ($\mu$mhos/cm) | 141 | 98 | 238 |
| Total Dissolved Solids (mg/L) | 81 | 55 | 141 |
| Major Cations (mg/L) | | | |
| Calcium | 11 | 8 | 20 |
| Magnesium | 10 | 5 | 17 |
| Sodium | 3 | 2 | 7 |
| Potassium | 1 | <1 | 2 |
| Major Anions (mg/L) | | | |
| Bicarbonate | 80 | 44 | 111 |
| Sulfate | 7 | 7 | 34 |
| Chloride | 2 | 2 | 2 |
| Hardness | 68 | 45 | 114 |
| Nutrients (mg/L) | | | |
| $NO_2$ + $NO_3$ | 0.32 | 0.43 | 1.82 |
| Ammonia | <0.1 | <0.1 | 0.1 |
| Kjeldahl Nitrogen | 0.1 | 0.1 | 0.36 |
| Dissolved Metals* (mg/L) | | | |
| Cadmium (0.001) | <0.001 (7) | 0.001 (7) | 0.001 (7) |
| Chromium (0.02) | <0.02 (8) | 0.02 | <0.02 |
| Copper (0.01) | <0.01 | <0.01 | <0.01 |
| Lead (0.01) | <0.01 | <0.01 (8) | <0.01 (7) |
| Nickel (0.03) | <0.03 | <0.03 (8) | <0.03 (7) |
| Zinc (0.01) | 0.01 | 0.01 | 0.02 |

Source: SMC, 1991b

* Parentheses indicates detection limit and sample size at the reported detection limit. See footnote on page 62.

### 3.2.3 Adit Water

SMC's underground workings produce, on average, approximately 500 gpm of water. The east side adit has produced on average about 244 gpm. The west side adit has produced approximately 263 gpm of water. Under the company's proposal, average flows from the adits are expected to increase to 789 gpm.

Table 3.2-4 Water Quality Stillwater Valley Ranch Monitoring Well

| Parameter | Location MW-14A | MW-12A, 13A, 15A | MW-12A, 13A, 15A |
|---|---|---|---|
| Begin Date | November 1990 | November 1990 | May 11, 1991 |
| End Date | May 1991 | January 1991 | May 11, 1991 |
| Sample Size | 6 | 11 | 3 |
| pH (Standard Units) | 7.0 | 7.0 | 7.4 |
| Specific Conductance (μmhos/cm) | 221 | 136 | 272 |
| Total Dissolved Solids (mg/L) | 143 | 96 | 167 |
| Major Cations (mg/L) | | | |
| Calcium | 22 | 13 | 26 |
| Magnesium | 15 | 9 | 19 |
| Sodium | 4 | 3 | 4 |
| Potassium | 1 | 1 | 1 |
| Major Anions (mg/L) | | | |
| Bicarbonate | 119 | 83 | 89 |
| Sulfate | 20 | 7 | 55 |
| Chloride | 2 | 1 | 4 |
| Hardness | 116 | 71 | 89 |
| Nutrients (mg/L) | | | |
| $NO_2$ + $NO_3$ | 1.01 | 0.11 | 3.48 |
| Ammonia | <0.1 | <0.1 | <0.1 |
| Kjeldahl Nitrogen | 0.2 | 0.1 | 0.1 |
| Orthophosphate | 0.01 | 0.01 | – |
| Dissolved Metals* (mg/L) | | | |
| Arsenic (0.005) | <0.005 (4) | <0.005 (6) | <0.001 |
| Cadmium (0.001) | <0.001 (6) | <0.001 (11) | 0.001 |
| Chromium (0.02) | <0.02 (3) | <0.02 (5) | <0.02 |
| Copper (0.01) | <0.01 (6) | 0.01 (11) | <0.01 |
| Iron (0.03) | <0.03 (4) | <0.03 (6) | <0.03 |
| Lead (0.01) | <0.01 (6) | 0.01 (11) | <0.01 |
| Manganese (0.02) | <0.02 (4) | <0.02 (6) | <0.02 |
| Molybdenum (0.005) | <0.005 (3) | <0.005 (6) | – |
| Nickel (0.01) | <0.01 (6) | <0.03 (5) | <0.01 |
| Zinc (0.01) | 0.03 (6) | 0.02 (6) | 0.01 |

Source: SMC, 1991b

* Parentheses indicates detection limit and sample size at the reported detection limit. See footnote on page 62.

Interception of water-bearing structure has occurred throughout project development, and can be expected to increase with continued development and production. Interception of major water-bearing structure has been relatively rare. Initial drifting in the Minneapolis Adit encountered flows of 170 gpm in one area. In the spring of 1988, east side development intersected structure that is believed to be connected to No Name Creek. East side inflows of 150 gpm have resulted in increased

adit discharge and subsequent reduction of the surface flow of No Name Creek. More recently, a 600-gpm interception occurred during extension of west-side development. Large flows from intersection of major water-bearing structure have dewatered rapidly, resulting in steady-state conditions that contribute moderately to average discharge volumes.

It has been observed that groundwater flow into the mine workings varies with seasonal and annual precipitation and recharge. This variation indicates that fracture systems are not perched, but rather connected to surface recharge. At the present time groundwater inflows average about 500 gpm.

Mine water from the west side adits is collected and directed to the west side clarifier (SMC-3). Similarly, mine water from the east side workings is collected and routed to the east side clarifier (SMC-9). Water quality samples are taken after the addition of flocculent. Tailings impoundment (SMC-4) water is also sampled on a regular basis. Results of this sampling are summarized in Table 3.2-5.

SMC currently uses Ferralyte 8130 Coagulant as a flocculating agent in the east and west side clarifiers. This product is an aqueous solution of ferric sulfate and a polyamine polymer which increases the settling rate of the particulate material. As with most chemical reagents, it requires careful handling in concentrated form. This product is approved by EPA for use in potable water supplies. A majority of the flocculent, as well as the settled material, is slurried to the tailing impoundment for permanent disposal. Overflow, or clarified water, is directed to either the irrigation system or percolation ponds, depending on the season.

Since blasting increases the concentration of nitrogen compounds in adit water, nitrate (nitrite plus nitrate) and ammonia have been monitored more frequently than most other parameters. The average concentration of nitrate and ammonia is 9.34 and 2.2 mg/L, respectively, for the west side adit (SMC-3), and, 5.27 and 0.5 mg/L, respectively, for the east side adit (Table 3.2-5). The combined averages are 8.4 and 1.8 mg/L for nitrate and ammonia (Table 3.2-6). These levels of nitrogen compounds are lower than those in most other operating hard rock mines in Montana. Nitrate levels can be minimized through proper usage of blasting compounds and minimizing contact with water.

Metal concentrations measured at the east side adit (SMC-9) indicate that both dissolved and total recoverable metal concentrations are at or below the limits of detection (Table 3.2-5). West side adit (SMC-3) concentrations are higher than the east side. The higher levels are most likely due to the data base used to develop these estimates. The west side clarifier was installed in August of 1989 and samples taken prior to this installation reflect the untreated condition. Clarifiers are highly effective for removal of particulate material. The other reason for higher concentration may be the greater degree of development and production on the west side.

Table 3.2-5 West Side Adit (SMC-3), East Side Adit (SMC-9) and Tailing Impoundment (SMC-4) Water Quality Data

| Parameter | Location SMC-3 | SMC-9 | SMC-4 |
|---|---|---|---|
| Begin Date | March 1987 | November 1988 | May 1987 |
| End Date | January 1991 | January 1991 | December 1990 |
| Sample Size | 15 | 9 | 8 |
| pH (Standard Units) | 7.3 | 7.8 | 7.2 |
| Specific Conductance (μmhos/cm) | 452 | 292 | 1,212 |
| Total Dissolved Solids (mg/L) | 262 | 132 | 966 |
| Total Suspended Solids (mg/L) | 85 | 113 | 87 |
| Major Cations (mg/L) | | | |
| Calcium | 53 | 23 | 150 |
| Magnesium | 6 | 6 | 18 |
| Sodium | 40 | 9 | 104 |
| Potassium | 2 | <1 | 5 |
| Major Anions (mg/L) | | | |
| Bicarbonate | 86 | 87 | 60 |
| Sulfate | 114 | 19 | 522 |
| Chloride | 7 | 2 | 23 |
| Hardness | 153 | 83 | 452 |
| Nutrients (mg/L) | | | |
| $NO_2 + NO_3$ | 9.34 | 5.27 | 14.73 |
| Ammonia | 2.20 | 0.50 | 1.83 |
| Kjeldahl Nitrogen | 3.10 | 0.40 | 2.31 |
| Total Phosphorus | – | – | 0.60 |

| Metals* | SMC-3 Dissolved | SMC-3 Total Rec. | SMC-9 Dissolved | SMC-9 Total Rec. | SMC-4 Dissolved | SMC-4 Total Rec. |
|---|---|---|---|---|---|---|
| Cadmium (0.001) | 0.001 (5) | <0.001 (5) | 0.001(6) | <0.001(3) | <0.001 (3) | <0.005 (3) |
| Chromium (0.02) | <0.02 (5) | 0.04 (5) | <0.02 (7) | 0.02 (3) | 0.02 (5) | 0.04 (3) |
| Copper (0.01) | <0.01 (10) | 0.02 (5) | <0.01 (7) | <0.01 (3) | <0.01 (5) | 0.02 (3) |
| Lead (0.01) | 0.01 (6) | 0.11 (5) | <0.01 (6) | <0.01 (3) | 0.01 (3) | 0.02 (3) |
| Nickel (0.03) | 0.03 (7) | 0.07 (5) | <0.03 (7) | <0.03 (3) | 0.03 (4) | 0.06 (3) |
| Zinc (0.01) | 0.01 (10) | 0.05 (5) | <0.01 (7) | 0.01 (3) | 0.11 (5) | 0.03 (3) |

Source: SMC, 1991b

* Parentheses indicates detection limit and sample size at the reported detection limit. See footnote on page 62.

Because of the concern for nondegradation, recent sampling by SMC has incorporated lower detection limits and additional parameters. These analyses included metals that are not necessarily associated with the Stillwater complex but may present health risks if present and are subsequently discharged to surface or groundwater. The results of these analyses indicate that antimony, arsenic, beryllium, mercury, selenium, silver and thallium, are below the limits of detection.

Table 3.2-6 Composite Adit Water Quality and Applicable Water Quality Standards

| Parameter | SMC Adit Water | Maximum Contaminant Level | Surface[1] Water Quality Standard |
|---|---|---|---|
| pH (Standard Units) | 7.5 | – | 6.5 to 8.5 |
| Total Dissolved Solids (mg/L) | 200 | – | 250 |
| Total Suspended Solids (mg/L) | 99 | – | – |
| Major Cations (mg/L) | | | |
| Calcium | 33 | – | – |
| Magnesium | 6 | – | – |
| Sodium | 22 | – | – |
| Potassium | <1 | – | – |
| Major Anions (mg/L) | | | |
| Sulfate | 71 | – | – |
| Nutrients (mg/L) | | | |
| Ammonia | 1.8 | – | 1.8[2] |
| $NO_2 + NO_3$ | 8.42 | 10.0 | 10.0* |

| Metals (mg/L) | Dissolved | Total Recoverable | Dissolved | Total Recoverable |
|---|---|---|---|---|
| Aluminum | 0.04 | 3.48 | – | – |
| Arsenic | <0.001 | <0.001 | 0.050 | 0.00002* |
| Barium | <0.1 | 0.005 | 1.0 | 1.0* |
| Cadmium** | 0.00005 | <0.0001 | 0.005 | 0.0003 |
| Chromium** | 0.004 | 0.015 | 0.05 | 0.055 |
| Copper** | 0.0006 | 0.028 | – | 0.003 |
| Iron | 0.03 | 1.85 | – | 0.3* |
| Lead** | 0.0004 | 0.007 | 0.015 | 0.0004 |
| Manganese | 0.02 | 0.03 | – | 0.05* |
| Mercury | <0.0002 | <0.0002 | 0.002 | 0.00001* |
| Nickel | <0.005 | 0.023 | – | 0.013* |
| Silver** | <0.0001 | <0.0005 | 0.05 | 0.0003 |
| Zinc** | 0.01 | 0.02 | – | 0.027 |

1) Freshwater chronic criteria unless otherwise noted.
2) Total ammonia (mg/L N) at ambient pH of 7.0 and 10°C.
* Human health criteria - Water and Fish Ingestion.
** Based on hardness of 20 mg/l (as $CaCO_2$).

Based on the results of the SMC monitoring program, extended detection limit analyses and periodic sampling by the agencies, a composite adit water quality profile has been developed (Table 3.2-6). This composite represents the adit water quality after treatment (clarification) and reflect the quality of the present mine discharge. These values will be used to estimate water quality impacts

(Chapter 4). Drinking water maximum contaminant levels (MCL) and surface water criteria are presented for reference.

## 3.3 Soils

A detailed (Order I) soil survey was conducted on about 5,320 acres in 1981. This included the 550-acre original permit area and all but 260 acres of the East Side Amendment area. Additional soil survey work was conducted on the 260-acre area in the spring of 1988. These soil surveys indicate the predominant soils in the project area developed in alluvial or glacial deposits. A large portion of the SMC's developments on both sides of the Stillwater River have occurred on old disturbances which has limited soil salvage. The natural soils in these old disturbed areas have not been described.

The predominant alluvial soils are Lolo and Nesda series. These soils in an undisturbed condition are mostly level (0-4 percent slopes) and are found on bottomlands and low level terraces along the Stillwater River. The upper horizons are characteristically dark-colored gravelly soil with soil textures ranging from loam to sandy loam. The upper horizons are about 15 inches thick. The average depth of salvageable soil was estimated at 8-9 inches of good materials with organic matter contents greater than 1 percent (Table 3.3-1).

The alluvial Lolo and Nesda subsoils have dark brown very gravelly horizons with soil textures similar to the surface horizons. These alluvial subsoils have 45-75 percent coarse fragments throughout the profile. The rocks are predominantly gravel size but some profiles may contain 25-35 percent cobbles. The subsoils were not included in soil salvage estimates because of rock content and/or a shallow depth to the water table.

The predominant glacial soils are Sebud and Tomy series. These soils occur along the lower slopes of the Stillwater River valley and are found on slopes from 4-40 percent. These soils are well drained and characteristically stony. Surface soil horizons are loam to sandy loam textured and grade to coarser textures at lower depths. About 25 percent of the surface is covered with stones and 5 percent is covered with boulders. Generally more stones are on the surfaces of crests of slopes rather than on lower slopes. The average depth of soil with fair salvage value ranges from 17-42 inches (Table 3.3-1).

Subsoils are pale brown to light yellowish brown and range in texture from stony clay loam to sandy loam to sand. Glacial subsoils were not recommended for salvage because of coarse fragment contents ranging from 30-65 percent of the soil volume and with sizes ranging from stone to boulders (Table 3.3-1).

Table 3.3-1 Soil Mapping Units Rated for Suitability as Source of Topsoil Material

| Unit | Unit Name Or Series | Slope | Topsoil Rating and Depth | | | Limitation |
|---|---|---|---|---|---|---|
| | | | Good (in.) | Fair (in.) | Poor or Unsuited (in.) | |
| 2 | Nesda Gravelly Loam | 0-4 | 8 | | | Gravel, water table |
| 2s | Nesda Loamy Sand | 0-4 | | 9 | | Gravel, water table |
| 4 | Cryofluvents Cryoborolls | 0-25 | | 10 | | Gravel, cobbles |
| 8 | Lolo Cobbly Loam | 0-4 | 8 | | | Gravel, water table |
| 9 | Nesda Gravelly Sandy Loam | 0-4 | 8 | | | Gravel, water table |
| 30, 31 | Sebud Stony Loam | 4-25 | | 42 | | Stones, boulders |
| 33 | Tomy Stony Sandy Loam | 4-40 | | 17 | | Stones, boulders |
| 37 | Taxi Stony Sandy Loam | 45-60 | | | 0 | Stones, slopes |
| 38 | Peel Sandy Loam | 0-5 | | 15 | | Coarse fragments |
| | Peel Stony Sandy Loam | 0-60 | | | 0 | Coarse fragments, slope |
| 41, 42 | Rock Outcrop, Part Sale | 40-70 | | | 0 | Bedrock, stones, slope |
| DS | Disturbed Soil | 0-25 | | | 0 | Not characterized, or chrome tailings |

* Information from Table 5.2-4, SMC 1988 Amended Operating Plan (SMC, 1988) and Table 2.8-1 of SMC 1984 Application for an Operating Plan (SMC, 1984).

Generally, soils in the SMC project area are moderately alkaline to moderately acid, are low in soluble salts and sodium, and are low to moderate in water and nutrient-holding capacity. Based on chemical data submitted by the company, there are no chemical elements in the soils that would pose a hazard to plants, animals, or humans (SMC EIS, Chapter III, p.25-28). Estimated salvage depths ranged from 0-84 inches. The predicted salvage depths were limited largely by coarse fragment contents, depth to water table, and depth to bedrock. In general, large amounts of potentially salvageable topsoil and subsoil layers exist with good and fair salvage value.

The proposed waste rock storage area on the east side of the Stillwater River covers 12.5 acres of disturbed soils covered with chrome tailings. Native soils underlying the chrome tailings have not been characterized.

SMC has committed to salvage 14,800 additional cubic yards of topsoil from the additional acres of proposed disturbances:

Table 3.3-2 Soil Replacement Volumes

| Mine disturbances | Replacement Volumes | | |
|---|---|---|---|
| | Approved | Proposed | Total |
| Tailing Impoundment | 12,000 lcy/66.3 acres | 2,000 lcy | 14,000 lcy/51.6 acres |
| Waste Rock Storage | none | 6,000 lcy/15 acres | 6,000 lcy/15 acres |
| Mill/mine support complex | 6,500 lcy/34 acres | 5,700 lcy/5 acres | 12,200 lcy/39 acres |
| Mine workings | 18,500 lcy/41.2 acres | 1,100 lcy/5 acres | 19,600 lcy/46.2 acres |
| Roads | 2,500 lcy/7.8 acres | 0 | 2,500 lcy/7.8 acres |
| Total | 39,500 lcy/149.3 acres | 14,800 lcy/10.3 acres | 54,300 lcy/159.6 acres |
| Average Replacement Depth/Acre | 1.6 settled inches | | 2.0 settled inches |

SMC has 32,500 lcy stockpiled and has used 6000 lcy for final reclamation. SMC will have a total of 54,300 lcy to reclaim almost 160 acres of disturbance. This equals a replacement depth of 2.0 inches of settled soil on mine disturbances.

## 3.4 Wildlife and Fisheries

### 3.4.1 Vegetation Types

The entire project area was included in the vegetation survey conducted during the original permit application process (Stillwater Project EIS, Chapter III, pages 28-35). Thirteen vegetation types, along with water, and disturbed sites supporting little or no vegetation were identified within the vegetation study area. These include stony grasslands, sagebrush shrublands, skunkbush shrublands, drainage bottomlands, riparian woodlands, ravine aspen-chokecherry, open forest-meadow

understory, open forest-rocky understory, douglas-fir forest, subalpine forest, revegetated chrome tailings, cultivated haylands, and disturbed lands.

Predominant tree species in forested areas are lodgepole pine, douglas fir and limber pine. Most trees are pole-sized, poorly formed saw timber. No significant commercial values exist in the area.

Many of the proposed disturbances are located on revegetated chrome tailings or previously disturbed lands.

Noxious weeds in the project area are scattered. Under SMC's approved weed control plan on file with the Stillwater County Weed Control Board, the county applies herbicide to control spread of weeds on open ground.

### 3.4.2 Local Wildlife Species of Concern

The Stillwater River Valley supports a diversity of wildlife, comprised of 143 species of birds, 34 species of mammals, 6 species of reptiles and one amphibian species. Many of these occur, at least seasonally, in the area potentially affected by the proposed action.

The proposed amendment area and adjoining areas contain a mixture of wildlife habitats including boulder/talus field, rock cliff/benches, closed douglas-fir forest, open douglas-fir forest, ravine aspen, riparian woodland, meadow, disturbed grassland, stony grassland and skunkbush shrubland.

Three big-game species occur regularly within the proposed permit amendment area: mule deer, white-tailed deer and bighorn sheep. Two other species, black bear and mountain lion, are frequently present. Two species that are present elsewhere in the Stillwater Valley, elk and moose, probably occur only rarely within the immediate project area.

Mule deer are the most abundant big-game species in and near the proposed permit amendment area. While some mule deer are present on the site yearlong, it is primarily winter/spring range. This habitat extends north and west for several miles, and supported nearly 6,000 deer in the early 1980's with six reasonably distinct population units; one of which occupies the proposed amendment area. During the peak of winter range occupancy, it is common to observe more than 100 mule deer in the five miles between the Stratton Ranch and Woodbine Campground, with half of these in or near the proposed amendment area. The number of mule deer in the proposed amendment area has remained stable or increased since the early 1980's (see also the Stillwater Project EIS, Chapter III, pages 41-46).

White-tailed deer occur yearlong in the riparian woodland along the Stillwater River. They are occasionally seen in the lower elevations of the proposed amendment area, primarily along the river. The number of white-tailed deer in the upper Stillwater Valley has increased since the early 1980's (see also the Stillwater Project EIS, Chapter III, pages 46-47).

The Stillwater Valley bighorn sheep population has declined significantly in recent years from a high of 60 animals in the winter of 1977-78 to a low of 24 animals in the winter of 1990-91. Between 1972 and 1982 this population supported an average annual lamb recruitment of 10.8 lambs per year. Since 1983 average lamb recruitment has declined to only 4.0 lambs per year. Since 1988 average lamb recruitment has been only 1.75 lambs per year. Between 1972 and 1985 adult ewe mortality averaged 7.7 percent annually. Since 1986 the ewe mortality rate has doubled to an average of 15.3 percent per year. Extinction of this population remains a real possibility if the population trend does not improve in the very near future (see IV-27 EIS, 1985).

Several potential sources of stress to the bighorn population have been identified. Habitat use patterns have changed dramatically since the 1970's, with significant increase in use of high-security habitats and a decrease in use of traditional habitats where forage quantity and quality was highest in the 1970's. The change in habitat use was accompanied by an increase in daily movements. Thus, energy expenditure was increased at the same time that energy intake was reduced. This pattern is thought to be, at least in part, the result of increased human activity on the winter range. There is also some evidence to suggest that forage composition on the winter range has changed since the 1970's, with a reduction in the forb component a major part of the bighorn sheep's winter diet. At the same time forage nutrition may have decreased, though data on this point are not conclusive. Increased numbers of mule deer and white-tailed deer on the traditional bighorn sheep winter range probably have resulted in increased competition for some forage species. Dietary overlap is probably greatest for forbs - the component of the winter range that is decreasing in availability. Additionally, portions of the winter range have been overgrazed by domestic cattle and horses in recent years. Lastly, there is some speculation that increased populations of predators, especially mountain lions, may be impacting the bighorn sheep, both in terms of direct mortality and increased energy expenditure due to harassment (SMC, 1991).

The cumulative affect of these stresses to the bighorn population has resulted in a dramatic increase in lungworm levels in the bighorn sheep. The high level of lungworm in conjunction with pneumonia (lungworm/pneumonia complex) is thought to be the primary cause of the increased mortality rate for bighorn lambs and ewes.

Numerous management activities are underway to address the many stress factors that appear to be operating against the Stillwater bighorn herd. Recent attempts to medicate the bighorns to reduce lungworm levels appear initially to have been successful. Several efforts are underway to improve the quality of the traditional winter range. An intensive domestic livestock grazing program

has been implemented to improve forage composition. Portions of the winter range have been reseeded with species that are highly palatable to bighorns. Other portions of the winter range have been treated with a controlled burn to stimulate plant nutrition and productivity. Direct fertilization of portions of the winter range is being explored. Human access to the winter range has been essentially eliminated between December 1 and April 15 each year. Attempts are also being made to reduce populations of mule and white-tailed deer through increased hunting pressure. Whether or not this management effort to reverse the bighorn's population trend will be successful remains unknown (SMC, 1991).

Black bears frequent the proposed permit amendment area during spring, summer, and fall. Black bears have also been known to den at upper elevations in the proposed amendment area. While there is no specific population data for this area, there is considerable evidence that the black bear population on the entire Beartooth face is declining. This decline is primarily due to excessive man-caused mortality (Shawn T. Stewart, Montana Department of Fish, Wildlife and Parks, (DFW&P) Pers. Comm., 1991).

Mountain lions are also frequently found in the proposed permit amendment area. During the winter of 1989-90, DFW&P personnel in cooperation with SMC employees captured and radio collared four lions on or near the permit amendment area. There was thought to be at least one other adult lion and two subadults in the immediate area that were not captured. Of these 7 lions there were probably only 3 resident adults. The radio-collared lions moved over a much larger area than just the proposed permit amendment area, but one adult female did spend a large portion of her time in and near this area. In general, the lion population across the Beartooth face appears to be increasing (Shawn T. Stewart, DFW&P, Pers. Comm. 1991).

Two species of upland game birds have been observed in or near the proposed permit amendment area. Blue grouse have been recorded in the open douglas-fir forest, particularly at higher elevations. Ruffed grouse have been seen in the ravine aspen and riparian wildlife habitat types. Both species are considered common although population levels have apparently declined in recent years (Shawn Stewart, DFW&P, Pers. Comm., 1991).

### 3.4.3 Threatened, Endangered, and Sensitive Species

The bald eagle is a federally listed endangered species that is known to occur in or near the permit amendment area. The majority of the eagle use occurs during the winter and spring when eagles migrate through the upper Stillwater Valley. Some birds reside along the river throughout the winter. Bald eagles are not known to nest in the area.

Additionally, the peregrine falcon is listed as an endangered species known to occur in or near the proposed permit amendment area. Peregrine falcons were known to nest on a cliff several miles

downstream from the proposed permit amendment area in 1975-76. There have been unconfirmed reports of activity near this site through the early 1980's. Peregrine falcons are also occasionally observed in the Stillwater in fall and winter. These observations are probably of migrating birds. There has been no evidence of nesting in or near the proposed permit amendment area.

Thirteen species of birds of prey have been recorded in the large study area encompassing the proposed permit amendment area. The proposed permit amendment area contains four habitats that are attractive nesting sites for raptors: cliffs (primarily for golden eagles), open douglas-fir forest (primarily for red-tailed hawks), and ravine aspen and riparian woodland (primarily for accipiters, red-tailed hawks and great horned owls). Other species such as the American kestrel and other species of owls may utilize all of these habitats.

There is one known raptor nest within the area affected by this proposed amendment. A golden eagle nest occurs on the cliff immediately above the SMC offices. This nest has only been active once since 1980 (in 1987). Golden eagles are frequently seen in the area but there has been no recent activity at the nest.

### 3.4.4 Fisheries

The Stillwater River and the West Fork Stillwater River near and downstream of the proposed permit amendment area are considered to be "substantial fisheries resources" (Jim Darling, DFW&P, Pers. Comm. 1988). Brown trout, rainbow trout, brook trout and mountain whitefish make up most of the fish biomass in the Stillwater River. Cutthrout trout were last collected in 1974. Rainbow-cutthroat hybrid trout are infrequently encountered. Non-game fish are also present throughout the river system.

The nature of the gravel substrate, shallow side channels, flow regimes, water quality and stream gradient make the Stillwater River above Beehive, Montana ideal for spawning and rearing game fish that live in the lower Stillwater and Yellowstone rivers. The aquatic invertebrate communities in the Stillwater River are highly diverse and abundant. May flies and true flies are the most highly distributed and diverse insect groups. Many of the may flies, stone flies and caddis flies are considered to be sensitive to environmental degradation and are indicative of good water quality and a healthy aquatic habitat.

The diversity of aquatic invertebrates found in three tributary streams (Nye Creek, Verdigris Creek, and Mountain View Creek) in the project area was much lower than in the Stillwater River. Nye Creek, which drains a portion of the amendment area, had the poorest diversity of aquatic organisms. Suitable habitat for aquatic insects in lower Nye Creek is limited by chromium mine tailings.

Fish populations in Nye Creek are apparently limited to salmonids, with brook trout the most abundant. Compared to the Stillwater, the tributary streams contain very limited fisheries potential.

## 3.5 Air Quality and Climate

### 3.5.1 Air Quality

Ambient air quality in the project area is generally very good. SMC operates two air quality monitors in the immediate mine area. The parameter monitored is PM-10 (particulate matter with a diameter of less than 10 microns). The results have shown that particulate levels have remained well below the applicable ambient air quality standards. The following table summarizes the data for calendar year 1990 and includes the standards for comparison.

Table 3.5-1 Summary of the PM-10 Suspended Particulate Data January, 1990 - December, 1990
Stillwater Mine, Nye, Montana

| Site | Ambient 24-hour Standard | Maximum 24-hour | Second Highest 24-hour | Ambient Annual Average | Arithmatic Annual Average | No. of Samples |
|---|---|---|---|---|---|---|
| 1 | 150* | 34 | 50 | 33 | 10 | 46 |
| 2 | 150* | 47 | 50 | 41 | 13 | 49 |

* Not to be exceeded more than once per year.
(Values are in micrograms per cubic meter)

The sampling has also included trace metal analyses of the particulate filters. These levels have also remained low and less than applicable guideline concentrations.

The major sources of particulate and gaseous air pollution in the area are the on-going mining activities, vehicle traffic, and wood burning. The surrounding area, including the Absaroka-Beartooth Wilderness, is designated as Class II under the Prevention of Significant Deterioration (PSD). The nearest Class I area is Yellowstone Park located about 20 miles to the south. Class I areas are provided the highest level of protection from air quality impacts under the PSD regulations.

Baseline air-quality monitoring was performed in the project area prior to the beginning of mining operations (July 1980 - July 1981). Total suspended particulate (TSP) monitoring sites were located at the Hertzler Ranch, the Beartooth Ranch, and the mine site. Results of this monitoring indicated quite low TSP levels, typical of natural background levels.

Computer simulation modeling of emissions submitted in support of SMC's original air quality permit application (not including activities under the proposed amendment) indicated a

moderate increase in TSP levels. The annual TSP level was estimated to increase to about 35 micrograms per cubic meter ($\mu g/m^3$). This compares to baseline levels of about 15-20 $\mu g/m^3$ and the annual TSP standard of 75 $\mu g/m^3$ which was in effect at the time.

### 3.5.2 Climatology and Meteorology

The climate of the area is described as modified continental. This type of climate is characterized by large daily and annual temperature ranges and marked differences in precipitation, temperature, and wind patterns over distances of only a few miles.

Average annual precipitation ranges from 20 to 25 inches. Over 53 percent of this falls during March through June. About 3.5 inches falls monthly during April, May, and June. The percentage of total precipitation occurring as snow increases with elevation. Below 5,000 feet snow accounts for 15 to 20 percent of the total, while above 9,000 feet snow sometimes accounts for as much as 90 percent.

Heavy thunderstorms occasionally take place in July and August and less frequently in June and September. There is a 20-percent chance a one-inch rainfall will occur in one hour in any given year, whereas a three-inch total in 24 hours could be expected one year in ten. Hailstorms also occur infrequently.

The annual average temperature is about 42°F and decreases with increasing elevation. At 10,000 feet, the average is estimated to be about 30°F. The warmest months are July and August and the coldest is January. At lower elevations the first freezing temperature in autumn normally occurs in mid-September and the last occurs in mid-June. At elevations above 7,500 feet, freezing temperatures may occur at any time.

Wind speed and direction were measured at the mine site and the Hertzler Ranch site from September 1, 1980, through August 31, 1981. Prevailing winds are from the southwest to the northwest throughout the year. The average wind speed was 10 miles per hour (mph) at the mine site and 7.4 mph at the Hertzler Ranch site. Only during August was the month's average wind speed lower at the mine site than at the Hertzler Ranch site. Maximum hourly wind speeds were usually greater at the mine site.

## 3.6 Land Uses

### 3.6.1 Recreation

The public utilizes the Woodbine Campground area heavily during the summer and fall months. Recreational activities consist of camping, fishing, and hiking. The public must travel through the bighorn sheep winter range on FAS 419 and FAS 400 in order to access the Woodbine Campground and Trailhead. The level of developed recreational use has remained the same over the last several years. However, use of the trailhead facilities leading into the Absaroka-Beartooth Wilderness has shown a slight decrease in visitor use.

### 3.6.2 Wilderness

The lowest elevation access point to the Absaroka-Beartooth Wilderness is located approximately 3.5 miles to the south of the Stillwater Mine. The area typically remains snow-free for extended periods of time during the winter months. Prior to 1988, the Woodbine trailhead experienced the highest use of any trailhead on the Beartooth Ranger District. During the summer of 1988, the area upstream of the trailhead experienced varying degrees of fire activity during the Storm Creek Fire. Following the burn, use in the area dropped. This use trend has continued to present.

Currently, access to the Absaroka-Beartooth Wilderness is precluded from December 1 to April 15 of each year. This measure was required by condition-of-approval mitigation measures contained in the 1989 EA/PER for the East Side Mine Expansion Amendment.

### 3.6.3 Beartooth Ranch Operation

This facility occupies a significant segment of the bighorn winter range. As currently managed, approximately 50 vehicles per day traverse the winter range on FAS 419. Per J. Richter (pers. comm. 11/88), about one-half of these trips could be related to SMC. The ranch is used as a source of lodging for business visitors. The forage base of the ranch is improving as compared to past range conditions.

### 3.6.4 Land Uses Outside the National Forest

Much of the land in the Stillwater Valley that is outside the national forest is privately owned, but there are also tracts owned by the state and some that are administered by the BLM. Lands near the mine that are not part of the CNF are used for agriculture, recreation, mining, residences, and wildlife habitat. Grazing is a major agricultural use in the valley, and Section 3.9.4 contains a more detailed discussion of the agricultural industry in Stillwater County.

Mining activity in the Stillwater Complex, of which this area is a part, began in the 1880's when sulfide-rich rocks containing copper and nickel were discovered (Page et al., 1985). Chromite also occurs in the Stillwater Complex, and the Benbow, Gish, and Mouat mines were developed in the early 1900's for the purpose of mining chromite. Over the years, chromite production from these mines was associated either with wartime needs or with U.S. government stockpiling programs, and chromite mining in the area ended in 1961 after the U.S. government did not renew the stockpiling contract with American Chrome Company. Increased interest in platinum-group metals in the Stillwater Complex in the 1960's and 1970's eventually led to the development of SMC's platinum palladium mine near the site of the Mouat operation. Thus, there is a long history of mining in the area which predates many of the other land uses.

The area contains both year-round and seasonal homes with FAS 420 a popular location for many of the seasonal structures. Subdivisions in the vicinity of the mine include the Cathedral Mountain Ranch, the Rainbow Ranch, the Whited subdivision, the Buffalo Jump Ranch, and the Stratton Ranch, which was developed to provide temporary mobile home accommodations to mine employees.

Recreational pursuits outside the national forest parallel those that occur on the national forest. Some of the more common recreational activities which people participate in are camping, picnicking, hunting, and fishing.

The use of the area for wildlife habitat is evaluated in Section 3.4.

## 3.7 Aesthetics

### 3.7.1 Visuals

The CNF manages its scenic resources with the USFS Visual Management System, which incorporates inventories of all of the forest's acres for visual attributes that will determine a rating of landscapes corresponding to management objectives. These VQO's are desirable limits of acceptable change that could take place as a result of management goals and objectives. As described in Volume 2, Chapter 1 of the National Forest Landscape Management System, VQO's allow for a certain degree of management activities to take place with respect to frequency, distance and type of visitor observation, and the ability of the landscape to absorb alteration. (See Chapter 4 for more detailed discussion of visual quality parameters.) Major travel and recreation corridors are usually the most sensitive, requiring the most stringent controls governing discernable changes in the natural landscape. Less traveled, lower standard roads reflect a descending hierarchy of visual constraints appropriate to the character of the land and the general purposes of the visitor. These objectives are listed below in order of least noticeable alteration to the most allowable, as seen by the average forest visitor:

PRESERVATION - allows for ecological changes or very low visual impact recreation activities.

RETENTION - allows for management activities that are not visually evident.

PARTIAL RETENTION - allows only for management activities that are visually subordinate to the characteristic landscape.

MODIFICATION - allows management activities to visually dominate the landscape only if they are in harmony with the naturally occurring form, line, color, texture, and scale of the characteristic landscape.

MAXIMUM MODIFICATION - allows management alterations to dominate the landscape and diverge from natural occurrences in foreground and middleground; however, these activities must be in harmony with the existing natural surroundings when viewed as background.

The landscape character of the project area is distinctive in landform and vegetative variety. From the broad, U-shaped, glacier valley floor where hay fields surround the riverbed to entire ridges of bare rock outcrop or steep slopes covered with stands of lodgepole pine or douglas fir, the area is an outstanding example of the Yellowstone Rockies character type. In addition, FAS 419 passes through the mine area to access the Absaroka-Beartooth Wilderness. For these reasons, the observed area of the forest near the mine site has been assigned the visual objective of Retention. The plant site, adits, and access roads within this area are also designated in the CNF Management Plan (USFS, 1986) as Management Area E with emphasis on mineral development. Public viewpoints of the plant site are numerous along the FAS 419 until it passes the site. There are also a limited number of points within the Cathedral Mountain Ranch subdivision that overlook part of the site at a distance of 2 to 3 miles. The desired future condition for the forest on potential mineral lands like these require minimizing disturbances and adverse impacts in the short term and the maintenance of sufficient controls during operations to assure the accomplishment of long-term goals. The Retention objective is expected to be met at some point after the life of the mine has expired and reclamation has been completed.

### 3.7.2 Noise

The mine currently works on an around-the-clock schedule, and utilizes car pooling for workers that commute from outlying areas. The increased production level and concomitant addition of personnel should not make a significant change in off-site noise levels from the present situation.

## 3.8 Socioeconomics/Traffic

The economic and social impacts of the proposed mine expansion would extend well beyond the project site, even as far away as Belgium where the matte produced from the Columbus smelter will be shipped for refining. Nevertheless, it is necessary to place a limit on the geographic scope of the economic and social analysis; so, based upon such considerations as the residential, shopping, and

commuting patterns of workers, the analysis area for the major economic and social impacts of the project is defined to be Stillwater County, Montana. This is consistent with the study area definition used in the December 1985 EIS and the affected jurisdictions included in the Hard Rock Mining Impact Plan.

### 3.8.1 Population

According to Bureau of the Census estimates, the population of Stillwater County on April 1, 1990 was 6,536, a 16.8 percent increase over the 1980 figure of 5,598. Over the last two decades, the rate of population growth in Stillwater County has exceeded that for both Montana and the United States (Figure 3.8-1). Although the expansion in the population slowed somewhat in the 1980's compared to the previous decade, the average annual rate of increase was still 1.6 percent, about 50 percent higher than the growth rate for the U.S. and 10 times the Montana rate.

The urban-to-rural migration which was prevalent throughout many areas of the United States in the 1970's appears to have been a factor in the population growth in Stillwater County, as does the development of the Stillwater Mine in the 1980's. The most recent Impact Plan Monitoring Data indicates that, of the total 364 employees of the mine, 222 (61.0 percent) were classified as in-migrants and 142 (39.0 percent) as residents. Using an average household size of 3.0 persons per employee as reported in the Impact Plan, this would mean that the mine would account for roughly 666 persons of the population increase.

Within Stillwater County, the population changes over the 1980-1990 period were, by no means, uniform. The largest population growth occurred in the Absarokee division[2], where the population rose from 1,407 in 1980 to 1,914 in 1990, an increase of 36.0 percent. The population of the Columbus and Park City divisions expanded by 14.8 and 14.3 percent, respectively, while the number of inhabitants of the Stillwater North division declined by 16.5 percent (96 persons) over the 1980-1990 period. The town of Columbus grew from 1,439 persons in 1980 to 1,573 in 1990, a 9.3 percent increase.

Given the proximity of Absarokee to the Stillwater Mine, it is not surprising that the population growth was concentrated in the Absarokee division. A February 1989 survey of SMC employees showed that 58.9 percent commuted from either Absarokee or between Absarokee and the mine, 21.4 percent from Laurel/Columbus, 10.0 percent from Red Lodge/Luther/Roscoe, and the remaining 9.7 percent from within 3 miles of the mine (SMC, 1989).

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[2]Since 1990 is the first year in which census data are available down to the block level for rural counties, population comparisons with 1980 for Stillwater County are made only for the larger census county divisions (CCD's).

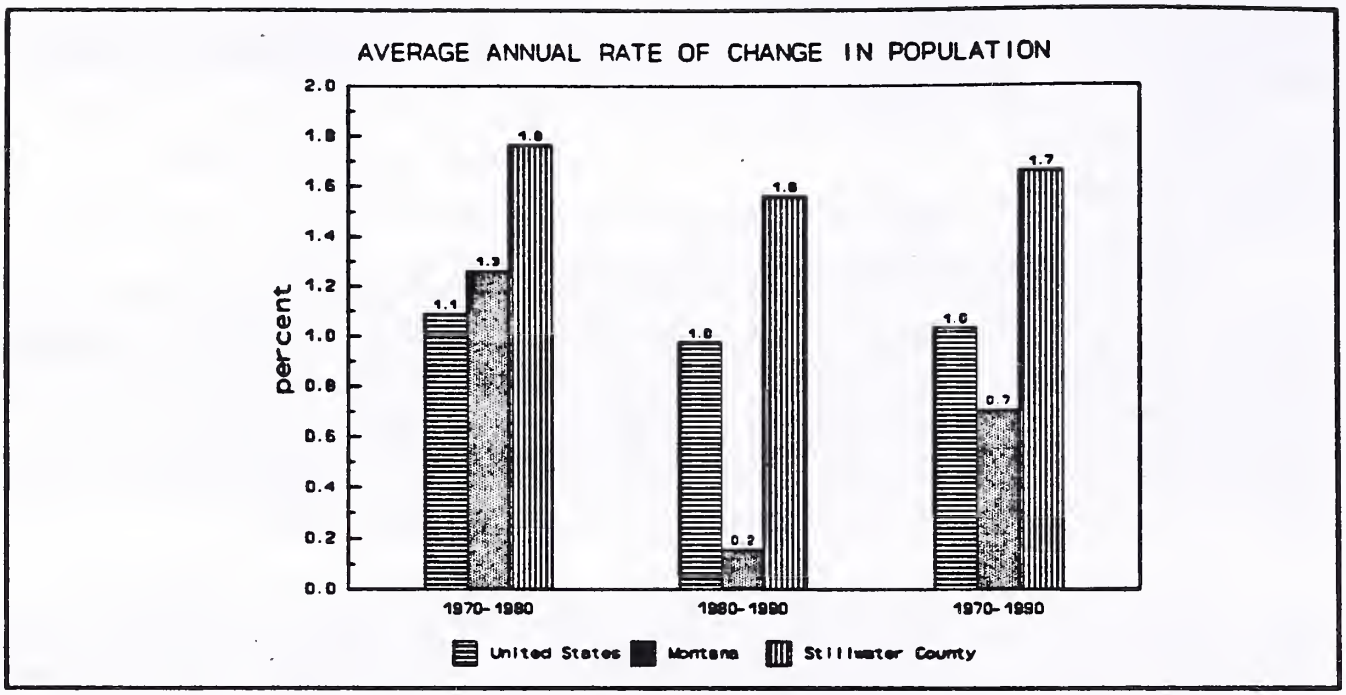


Figure 3.8-1 Average Annual Rate of Change in Population

Figure 3.8-2 shows the relative distribution of the population, by race, for the United States, Montana, and Stillwater County based upon census data for 1990. As seen in this bar graph, racial minorities account for a smaller percentage of the population in Stillwater County than in Montana or the United States, as a whole. American Indians were the largest racial minority in the county, making up 0.8 percent of the population. Persons of Hispanic origin, who may be of any race, constituted the largest minority group at 1.4 percent of the 1990 Stillwater County population compared to 1.5 percent for the state and 9.0 percent for the U.S.

Data from the 1990 census on the distribution of the population by age shows that the Stillwater County population tends to be somewhat older than the statewide average which could be a reflection of the lack of job opportunities for younger residents or the attractiveness of the area to retirees. The median age in Stillwater County is 36.5 years compared to 33.8 years for the state. Persons 65 years of age and older account for 16.7 percent of the Stillwater County population while 13.3 percent of the Montana residents are in that category. The proportion of females in the Stillwater County population is slightly lower than that of the state (50.1 percent for Stillwater County versus 50.5 percent for Montana).

### 3.8.2 Labor Force

The civilian labor force in Stillwater County averaged 3,347 in 1990 with 3,229 employed and 118 unemployed. The unemployment rate was, therefore, 3.5 percent, much lower than the statewide or U.S. figures. In the early 1980's, the Stillwater County unemployment rate was also substantially below the U.S. and Montana rates, but the rate more than doubled in 1982 and rose again in 1983, putting Stillwater County above the others (Figure 3.8-3).

Wage and salary employment, which is on a place-of-work basis, did not change nearly as much as the number of unemployed (place-of-residence basis), suggesting that a large portion of the newly unemployed came from workers who were commuting to other counties for their jobs. During 1982 and 1983, several developments occurred in other counties which may have affected Stillwater County residents. Among these were the shutdown of highway construction near Big Timber due to a labor dispute between operating engineers and general contractors, layoffs in the food processing industry in Billings, and cutbacks at the railroad in Laurel (Research and Analysis Bureau, various quarters).

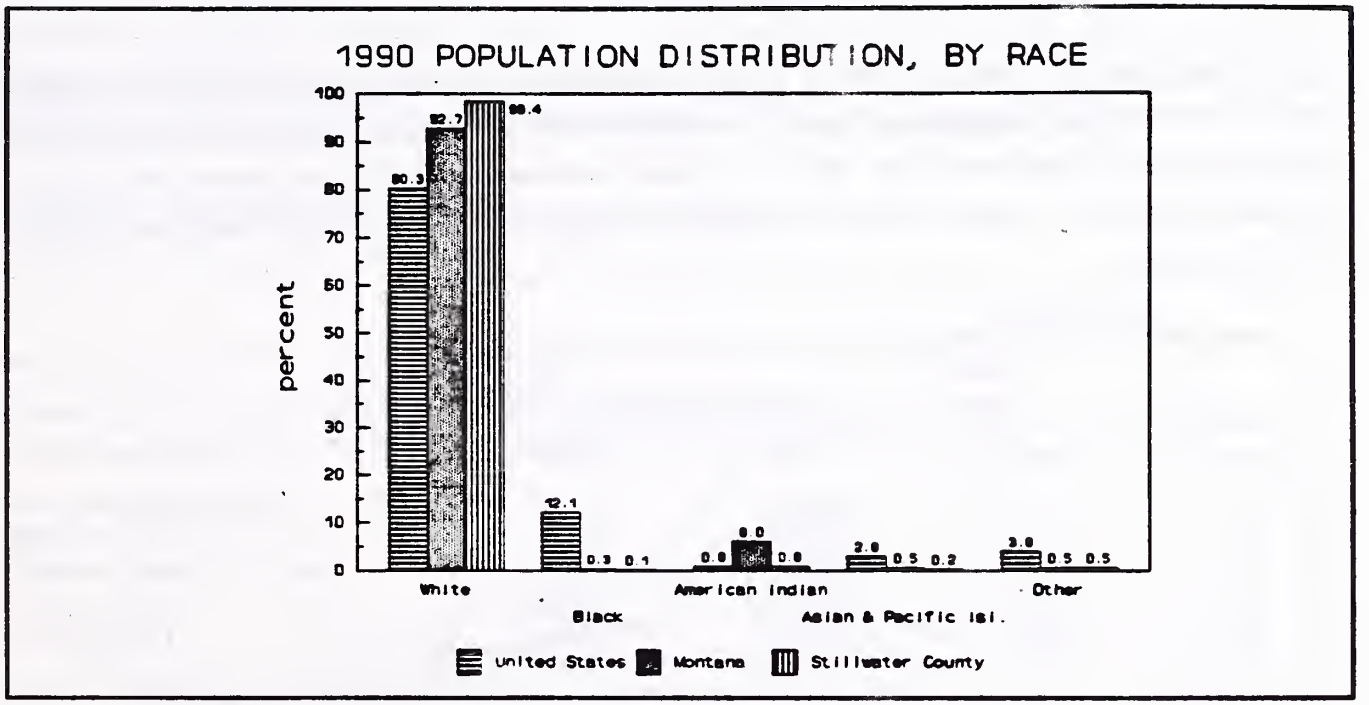


Figure 3.8-2 1990 Population Distribution, by Race

Hiring at the Stillwater Mine reduced the number of unemployed, and over the 1988-1990 period the jobless rate in the county was below that of the U.S. and Montana. In March of 1991, however, the Stillwater County unemployment rate jumped to 10.6 percent of the work force as a result of about one-fourth of the workers at the Stillwater Mine being laid off in a move designed to lower costs. By June, the unemployment rate had declined somewhat to 9.1 percent, but was still well above the unemployment rate for Montana and the United States. In comparing the Quarterly Impact Monitoring Reports for December 31, 1990 and March 31, 1991, resident employment fell by 89 persons, while 30 of the in-migrating employees lost their jobs. Thus, residents, who comprised 47.8 percent of Stillwater mine employees on December 31, 1990, made up a disproportionate share

Table 3.8-1 Labor Force Statistics for Stillwater County

| | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|
| Labor Force | 2,685 | 3,063 | 3,153 | 3,285 | 3,347 |
| Employment | 2,462 | 2,869 | 3,012 | 3,145 | 3,229 |
| Unemployment | 223 | 194 | 141 | 140 | 118 |
| Unemployment Rate | 8.3% | 6.3% | 4.5% | 4.3% | 3.5% |

Source: Research and Analysis Bureau, June 1990 and 1991.

of the March layoffs. Over the January 31, 1990 to December 31, 1990 period, however, resident employment rose by 44 persons while only 1 additional job was filled by a nonresident of the county. The most-recently hired employees, who were mostly residents, likely did not possess the level of skill and experience of others already working at the mine, so they were more vulnerable when the layoffs occurred.

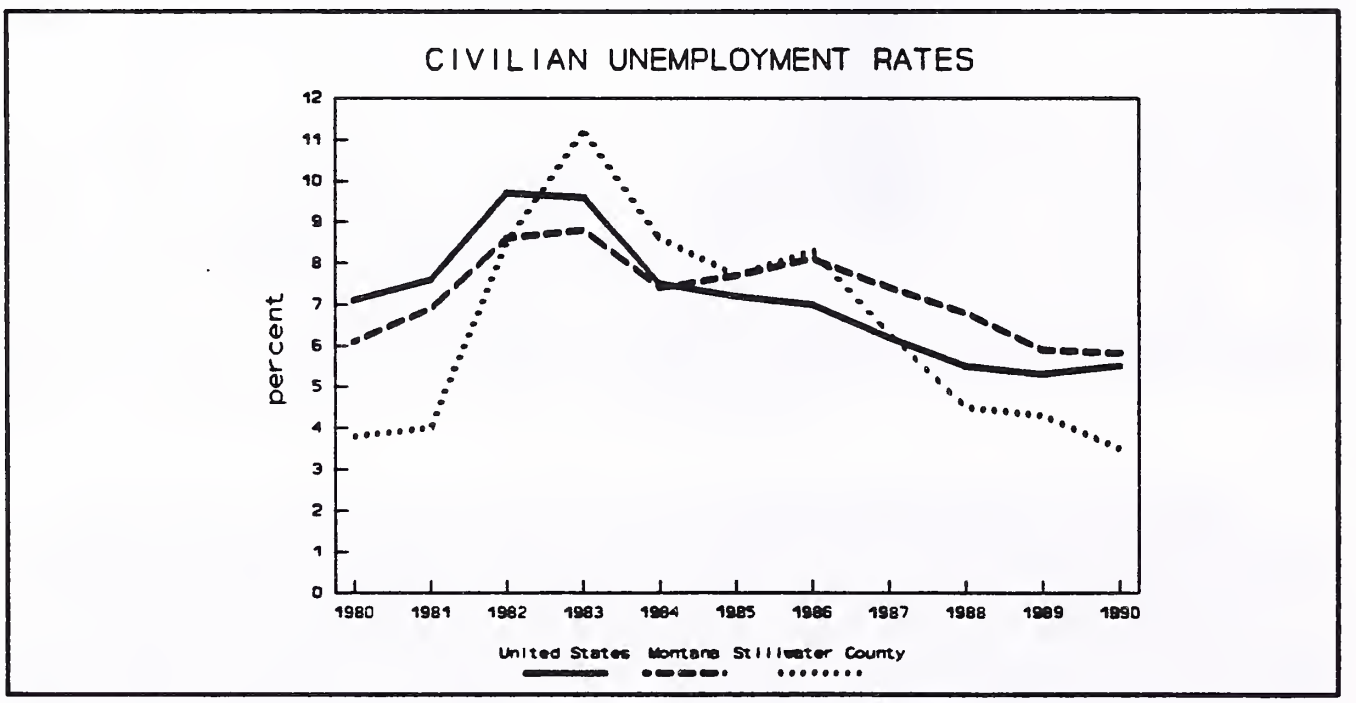


Figure 3.8-3 Civilian Unemployment Rates

### 3.8.3 Personal Income

Personal income is the income received by persons from all sources including wages and salaries, proprietors' income, transfer payments, dividends, interest and rents. Expressed in constant 1990 dollars, personal income totalled $107.6 million in 1989. Labor income accounted for 50.8 percent ($54.6 million) of the total, a far lower percentage than for the state (Table 3.8-2). The residence adjustment for income earned outside Stillwater County made up a much larger percentage of personal income, 12.6 percent, than the statewide figure. The labor income and residence

adjustment percentages are indications of the degree of commuting that occurs by Stillwater County residents to jobs in other areas (e.g., Billings) and the attractiveness of Stillwater County as a place to live.

Per capita income, a measure of economic well-being, was $16,742 in Stillwater County in 1989, compared to $18,474 for the U.S. and $14,857 for Montana. Per capita income for Stillwater County and Montana was, therefore, 90.6 percent and 80.4 percent, respectively, of the U.S. amount. The per capita income was relatively equal among the United States, Montana, and Stillwater County in the early to mid-1970's, but after that, the per capita income in the U.S. continued to rise while Montana and Stillwater County remained flat (Figure 3.8-4). With the opening of the mine, the gap between the U.S. per capita income and that of Stillwater County has been narrowing.

Table 3.8-2 1989 Personal Income by Major Component

| | | | Percent of Total | |
|---|---|---|---|---|
| | Stillwater County | Montana | Stillwater County | Montana |
| Total Personal Income | 107,563 | 11,962,558 | 100.0 | 100.0 |
| Social Security contribution | -3,963 | -576,069 | -3.7 | -4.8 |
| Residence adjustment | 13,531 | 14,335 | 12.6 | 0.1 |
| Dividends, interest, and rents | 24,933 | 2,554,847 | 23.2 | 21.4 |
| Transfer payments | 18,430 | 2,234,021 | 17.1 | 18.7 |
| Labor Income | 54,631 | 7,735,425 | 50.8 | 64.7 |

Source: University of Montana Bureau of Business and Economic Research, July 1990

Note: Social Security contributions are deducted from other components to derive total personal income.

### 3.8.4 Structure of the Local Economy

The distribution of labor income among major industries provides some insight into the structure of an economy. Table 3.8-3 shows labor income for Stillwater County and Montana. Because of the limited number of firms in the mining and manufacturing industries in Stillwater County, labor income for those categories is not disclosed by the Bureau of Economic Analysis. Data published by the Montana Department of Labor, however, suggests that mining accounts for over one-fourth of total labor income, while labor income in manufacturing is fairly close to the statewide figure of 8.4 percent. Compared to the state, agriculture and mining are relatively more important industries with most others making up a smaller percentage of total labor income than corresponding industries in the state. Lower percentages for such industries as trade, services, and finance, insurance, and real estate show that residents leave the county to purchase many goods and services.

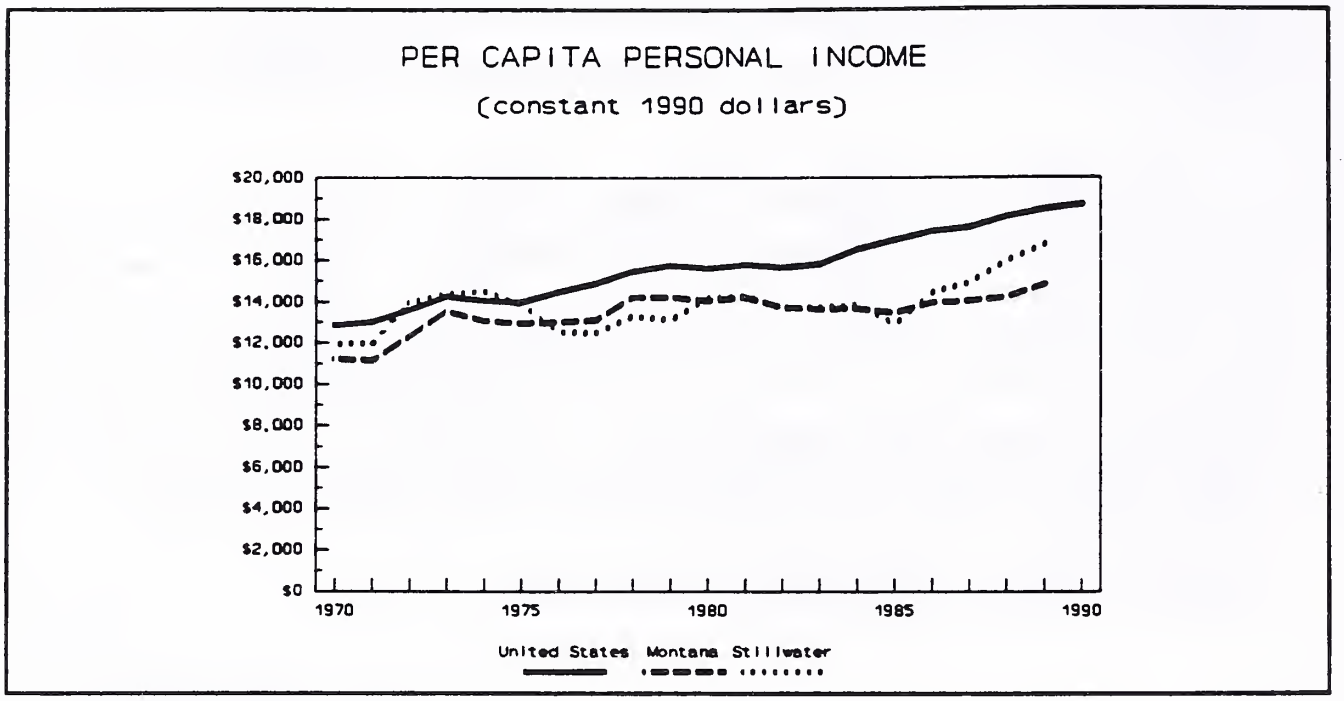

Figure 3.8-4 Per Capita Personal Income

Table 3.8-3 1989 Labor Income by Major Industry Stillwater County and Montana (thousands of 1990 dollars)

| | | | Percent of Total | |
|---|---|---|---|---|
| | Stillwater County | Montana | Stillwater County | Montana |
| Total Labor Income | 54,631 | 7,735,425 | 100.0 | 100.0 |
| Agriculture | 7,669 | 498,093 | 14.0 | 6.4 |
| Agricultural Services, Forestry and Fisheries | 345 | 55,332 | 0.6 | 0.7 |
| Mining | (D) | 260,108 | (D) | 3.4 |
| Construction | 1,908 | 425,499 | 3.5 | 5.5 |
| Manufacturing | (D) | 650,236 | (D) | 8.4 |
| Transportation, Communications and Public Utilities | 2,311 | 756,265 | 4.2 | 9.8 |
| Wholesale Trade | 1,240 | 405,844 | 2.3 | 5.2 |
| Retail Trade | 4,437 | 892,510 | 8.1 | 11.5 |
| Finance, Insurance, and Real Estate | 291 | 329,380 | 0.5 | 4.3 |
| Services | 7,033 | 1,867,462 | 12.9 | 24.1 |
| Government | 6,856 | 1,594,696 | 12.5 | 20.6 |
| Federal Civilian | 881 | 413,879 | 1.6 | 5.4 |
| Federal Military | 254 | 139,807 | 0.5 | 1.8 |
| State and Local | 5,721 | 1,041,009 | 10.5 | 13.5 |

(D) Not shown to avoid disclosure of confidential data. Data included in totals.

Source: Bureau of Economic Analysis, April 1991.

For rural counties, this parallels the behavior observed at the statewide level. Swanson (1991) has categorized Montana counties into a trade center hierarchy with six tiers. Tier 1 counties, including Stillwater County, are the least populated with the number of residents less than 5,000. At the top of the hierarchy are the Tier 6 counties (Cascade, Missoula, and Yellowstone) whose population is greater than 60,000. According to Swanson, retail trade activity has been shifting up

the trade hierarchy over the years. Between 1972 and 1987, retail sales, measured in constant dollars, have dropped by 31 percent in the Tier 1 counties, compared to an increase of over 20 percent for the Tier 5 and 6 counties. The services sector also has been growing more rapidly in the more populated counties, as evidenced by the increase in service's industry labor income of over 100 percent in Tiers 5 and 6 between 1972 and 1988, while the expansion in labor income in the Tier 1 counties was a much lower 31 percent.

Table 3.8-4 Covered Employment and Wages In Stillwater County, Montana-1989

| | Number of Establishments | Average Annual Employment | Average Annual Wage |
|---|---|---|---|
| Agricultural Services, Forestry, and Fisheries | 9 | 37 | $14,369 |
| Mining | 6 | 436 | 32,277 |
| Construction | 18 | 41 | 18,736 |
| Manufacturing | 10 | 194 | 19,760 |
| Transportation, Communications, and Public Utilities | 8 | 40 | 23,523 |
| Wholesale Trade | 19 | 43 | 21,074 |
| Retail Trade | 38 | 231 | 10,900 |
| Finance, Insurance, and Real Estate | 3 | 20 | 16,258 |
| Services | 37 | 256 | 9,138 |
| Government | 27 | 329 | 17,424 |
| Local | 12 | 274 | 16,909 |
| State | 7 | 16 | 24,116 |
| Federal | 8 | 39 | 18,292 |
| Unclassified | 3 | 6 | 7,001 |
| Total | 178 | 1,633 | $19,589 |

Source: Research and Analysis Bureau, 1990.

According to the most recent Census of Agriculture, there were 447 farms in Stillwater County in 1987, 4.2 percent more than in 1982 when the previous census was made. The amount of land in Stillwater County farms declined, however, to a level of 842,673 acres, resulting in an average farm size for the county of 1,885 acres. On average, farms in Stillwater County are roughly 4 times the size of the average U.S. farm, but 23.1 percent smaller than the statewide figure.

The market value of agricultural products sold in Stillwater County totalled $26.2 million in 1987 compared to $23.8 million in 1982. When adjusted for inflation, however, the 1987 value was 6.2 percent less than 5 years earlier. The average value of agricultural products sold per farm was $58,637 in 1987 in Stillwater County, which was lower than the average for Montana and the U.S. Over three-fourths of the value was generated from the sale of livestock, poultry, and their products and just under one-fourth from crops. In 1982, livestock and poultry accounted for 63 percent of the total value of products sold. Cattle and calves make up the largest component of livestock and

poultry sold in Stillwater County with hogs and pigs, sheep and lambs, and chickens also important. Wheat was the dominant crop grown in the county in 1987, and hay, barley, and corn were other crops that were harvested.

Table 3.8-5 Farm Statistics - 1982 and 1987

| | Number of Farms | | Average Size (acres) | | Market Value of Agricultural Products Sold (average per farm) | |
|---|---|---|---|---|---|---|
| | 1987 | 1982 | 1987 | 1982 | 1987 | 1982 |
| United States | 2,087,759 | 2,240,976 | 462 | 440 | $65,165 | $58,858 |
| Montana | 24,568 | 23,570 | 2,451 | 2,568 | 62,980 | 65,641 |
| Stillwater County | 447 | 429 | 1,885 | 2,012 | 58,637 | 55,500 |

Source: Bureau of the Census, March 1989 and May 1989.

### 3.8.5 Housing

The total number of housing units in Stillwater County increased by 22.8 percent between 1980 and 1990, compared to 10.0 percent for Montana. The Absarokee division absorbed a good portion of the expansion with a jump of 32.5 percent, but the Columbus and Park City divisions also recorded increases (20.7 percent for Columbus and 24.9 percent for Park City). The town of Columbus added 79 units to the housing stock, 13.1 percent above the 1980 level. The number of housing units in the Stillwater North division, the least populated in the county, contracted by 6.9 percent.

The housing market in Stillwater County is generally viewed as tight, particularly for rentals. The homeowner and rental vacancy rates in Stillwater County as of April 1, 1990 were 2.6 percent and 9.5 percent, respectively, slightly below the statewide vacancy rates of 2.9 percent for homeowners and 9.6 percent for rentals. These Stillwater County vacancy rates are not indicative of a tight market, but one possible explanation for this is that unoccupied seasonal, recreational, or occasional-use units make up an unusually large percentage of the vacant units in the county. Fully 55.7 percent of the vacant units in Stillwater County were in the seasonal, recreational, or occasional-use category compared to 37.2 percent for Montana. Thus, the vacancy rates for year-round units would be more in line with people's perception of the state of the real estate market than the statistics would indicate.

Those moving into Stillwater County to work at the mine have often had to accept temporary accommodations until something more suitable opens up. Included among the temporary arrangements have been renting vacation homes or mobile homes. Many of the in-migrants do not have the financial resources to purchase an existing home or build a new one, so there is a substantial

amount of competition for the limited rentals which become available. Rents have, therefore, increased significantly according to those familiar with the real estate market in Stillwater County. Census data indicates that contract rents in Stillwater County rose an average of 5.9 percent per year over the 1980 to 1990 period compared to 4.3 percent for the state. Although the rate of increase in Stillwater County is not all that much higher than for the state, it seems likely that much of the increase in Stillwater County was concentrated in the last half of the decade.

Home prices in Stillwater County have been categorized as stable, and census data show that the median value of owner-occupied homes has not appreciated to the degree that rents have, increasing an average of 2.7 percent per year from 1980-1990. The relatively more stable housing prices are probably due to the previously mentioned concept that the demand for houses to buy is constrained by the limited financial resources of those moving into the community.

Actions taken by SMC to help employees find housing include the purchase and development of the Stratton and Circle T ranches. The Stratton Ranch was designed to provide temporary housing for employees in a mobile home setting until they were able to find more permanent accommodations. The Stratton Ranch was designed for a maximum of 32 mobile homes, and SMC guaranteed the loans for employees to purchase the mobile homes. SMC plans to phase out the facility over the next 3-5 years. New occupants are no longer allowed to move onto the ranch, and when a mobile home is vacated, it is removed. Once all the mobile homes are removed, the area will then be reclaimed.

The Circle T Ranch was subdivided by SMC and employees can purchase the lots at a cost below what SMC has invested in the development. Apparently, the purchase price to the employee also tends to be less than the market value. Water, and power are provided to the lots, but individual septic systems must be installed. Of the 59 lots in the subdivision, 37 have been sold and 22 are still available for purchase.

### 3.8.6 Community Services and Facilities

The Hard Rock Mining Impact Act of 1981, as amended, requires new mining operations with more than 75 employees to formulate a plan which describes how the developer will mitigate adverse impacts on local governments. The plan indicates which local jurisdictions are affected by the mine development, an estimate of the impacts, a description of the mitigation measures and thresholds for when the measures would be triggered, conditions for an amendment, and provisions for monitoring.

In the case of the original Hard Rock Mining Impact Plan for the Stillwater Mine, which was signed in 1985 (SMC, 1985), and the 1988 amendment (SMC, 1988), which was triggered by an increase in the number of employees at the mine, the affected local jurisdictions were defined to include Stillwater County, the Town of Columbus, the Absarokee Rural Fire District, and school

districts in Absarokee, Columbus, Fishtail, and Nye. Among the needs identified by these jurisdictions were additional personnel (e.g., for law enforcement, planning, social programs, schools, and road maintenance); greater funding for such items as court operations, libraries, mental health programs, and assistance to low-income individuals; and facilities and equipment (e.g., new schools, fire trucks). The plan establishes that SMC will provide mitigation in the form of tax prepayments, grants, and guarantees for the payment of principal and interest on educational impact bonds.

A significant amount of such financial assistance has already been provided by the SMC to the affected local jurisdictions, and the general impression one gets when talking to local officials is that the Hard Rock Mining Economic Impact Plan is working very well. Most people seem to feel that the financial mitigation has enabled the communities to better accommodate the growth which has occurred.

In spite of the mitigation, there are still concerns over the ability to provide services to the Stillwater County residents. The sewer system for the Town of Columbus is at capacity, and water lines in Columbus are in need of upgrading. The additional traffic from the population growth has resulted in unmet street maintenance needs, and it would be desirable to pave some of the gravel streets which have experienced greater traffic. With the hiring of additional law enforcement personnel, their office space has become inadequate. Emergency services, fire protection, and other services are generally considered to have improved with the implementation of Impact Plan.

March 31, 1991 enrollment figures for certain school districts in Stillwater County are shown in Table 3.8-6. In-migrating mineral development students are defined as students whose parent or guardian moved into the area to work at the mine. Compared to the period before the mine was developed, enrollment has increased in Absarokee, Columbus, and Fishtail elementary schools and Absarokee High School, while the student population fell at Nye Elementary and Columbus High School. In-migrating mineral development students accounted for the entire enrollment increases in the Absarokee schools, but were less of a factor in the expansion in the Columbus and Fishtail elementary districts. Absarokee accepts some students from other districts (e.g., Fishtail) on a tuition-paying basis.

As of the beginning of the 1991-1992 school year, enrollment at Nye and Fishtail elementary schools had declined somewhat from the previous year while little change was observed at the Absarokee schools. The Absarokee schools have a limited capability to absorb future increases in enrollment, particularly at the elementary level, but the Fishtail and Nye elementary schools could accommodate more students. The Columbus school system is at capacity at the elementary level, both in terms of class size and physical facilities. The junior and senior high schools are not as crowded, so increases in enrollment would not pose as big a problem as at the elementary level.

Table 3.8-6 Enrollment in Stillwater County Schools March 31, 1991

| Elementary School Districts | Total Enrollment | In-migrating Mineral Development Students |
|---|---|---|
| Absarokee | 259 | 78 |
| Columbus | 392 | 29 |
| Fishtail | 40 | 4 |
| Nye | 4 | 4 |
| Total | 695 | 115 |

| High School Districts | Total Enrollment | In-migrating Mineral Development Students |
|---|---|---|
| Absarokee | 132 | 36 |
| Columbus | 130 | 18 |
| Total | 262 | 54 |

Source: Stillwater Mining Company, March 31, 1990.

3.8.7 Attitudes, Beliefs, and Values

The Entercom report (1981) contains information on how people feel about living in Stillwater County and their perceptions about mine development. Although the survey on which the report is based took place 10 years ago, before the development of the mine, many of the responses to the survey still seem relevant today. To summarize the results of the survey, the residents were satisfied with the quality of life in Stillwater County, citing the friendly people, the small population, and the physical attractiveness of the area as major advantages of living there. Disadvantages of living in Stillwater County, according to the respondents, included the lack of cultural/social activities, and limited shopping and employment opportunities. The disadvantage mentioned most often, however, was the condition of the roads.

With respect to mine development, residents viewed the major benefits as being greater job opportunities, a broader tax base, and a boost to the local economy. Concerns that were expressed about mine development included the potential for growth to occur too rapidly, the possibility that individuals moving into the area would be undesirable, the additional demands placed upon public services, and the effects on air and water quality.

Recent discussions with local residents, including local government employees, school officials, and business owners, indicate that, initially, the in-migrating mine workers and their families may have been perceived by some as "outsiders," but, over time, this attitude has become less prevalent. Unsolicited praise for the involvement of the new residents in community activities was offered on several occasions. On the negative side, certain landlords have apparently had problems with nonresidents who moved into Stillwater County to work at the mine, and some children

of in-migrating mine workers, especially those who have come from another state, have experienced difficulties in adjusting to a new school system.

The March layoffs at the mine have resulted in the emergence of an additional concern among local residents. When the Entercom survey was conducted in 1981, residents felt that, if the mine were developed, the local economy would become more stable. There is now a concern that too heavy a reliance on the mining industry may have a destabilizing effect on the local economy and cause a number of problems which could potentially be avoided if the economy were more diversified.

### 3.8.8 Property Tax Base

One of the issues discussed in Chapter 1 is whether the mine has been responsible for increases in property taxes in Stillwater County over the past few years. Higher property taxes can be the result of an increase in mill levies, a rise in the taxable value of property, or a combination of the two. Special levies and school district levies cause total mill levies to vary according to the location of the property within the county, but information from the Montana Tax Foundation (1984) and the Stillwater County Assessor's Office (1991) indicate that levies applicable county-wide have risen from 157.87 mills in the 1984-1985 fiscal year to 201.85 mills for 1990-1991.

Although the levies for some of the individual categories have changed over this period (e.g., school levies rose after the removal of the freeze imposed by I-105), the increase is, in large part, attributable to a new levy of 40 mills which resulted from action taken by the 1989 Montana legislature. The purpose of the additional 40 mills is to equalize school funding, and the levy is applicable to every county in the state. Thus, it would appear that the increase in mill levies in Stillwater County is not related to the mine.

As indicated above, the amount of property taxes paid also depends upon the taxable value of the property under consideration. On an aggregate basis, the taxable value of property in Stillwater County is affected by, for example, the construction of new housing units as well as trends in the value of existing units. The taxable value of Stillwater County property totalled $19.5 million for fiscal year 1991-1992, and in constant dollar terms, the taxable value has grown at an average rate of 0.2 percent annually since the 1982-1983 fiscal year. By contrast, information available for the state shows the taxable value of property in Montana actually declined in both nominal and real terms over this same period. Excluding the value of the property owned by the SMC, the taxable value of property in Stillwater County for fiscal year 1991-1992 is approximately $16.1 million, about $3 million lower, in constant dollars, than 9 years earlier.

The mine may be indirectly responsible for higher property taxes to the extent that any increases in house prices were caused by a rise in the demand for housing brought about by the

development of the mine. Available data indicate, however, that housing prices in Stillwater County have increased at a rather modest rate over the 1980-1990 period, probably even less than the rate of inflation (see Section 3.8.5). Thus, it is likely that the development of the mine has had a negligible impact on housing prices, and the increase in property taxes in Stillwater County is due to other factors.

SMC is a significant source of property tax revenue to the county. The 1991-1992 property tax liability of the company is approximately $964,300. This includes the tax on the smelter in Columbus and the tax on that portion of the gross proceeds from the mine subject to property taxes. In addition, SMC pays a metal mines license tax to the state on the gross proceeds from the mine, and 25 percent of that is returned to the county. At least 40 percent of the county's share must be put in a reserve for use when the mine closes or a substantial reduction in employment occurs.

### 3.8.9 Mine Access Corridors and Use Patterns

Review of Past Permitting Documents

1985 EIS

During the scoping effort for the Stillwater Project EIS (pg. IN-4), the public expressed concerns related to potential traffic volume increases due to implementation of SMC's Plan of Operations. These concerns include accelerated degradation of road conditions, impacts to the quality of life for Stillwater County residences who live along the heavily used access routes, and decreased safety while driving these access corridors.

The 1985 EIS for the Stillwater Project (pg. III-77 to 79) described pre-mine development use patterns for FAS 419, FAS 420, and FAP 78. Use of these access corridors was expected to increase due to implementation of SMC's Plan of Operation. It is important to note that use of these roads were expected to increase by 3.5% to 4.0% annually, even if implementation of the Stillwater Mine had not occurred. The traffic accident rate in the early 1980's on all the roads in the project area was significantly above the average for similar type roads statewide. The predominate reason for this situation was thought to be the poor alignment and conditions of the access routes.

Analysis contained within the EIS (pages IV-53 to 57), projected an increase in accident rates, increased road maintenance cost, and negative impacts to county residences living along the access corridors related to implementation of the company's proposal. It must be noted that the company's proposal did not mention any attempt on the company's part to reduce mine related traffic.

Mitigation aimed at reducing the mine related traffic impacts by 66% was prescribed via the 1985 Record of Decision (page 15).

1989 East Side EA/PER

The scoping effort for this document identified a number of concerns from both the public and the regulatory agencies (Chapter I, pg. 6). Most of these concerns related to potential traffic increases due to bringing the East Side of the Stillwater River into production. Additionally, the public expressed concerns related to SMC non-attainment of the previously prescribed 3.0 passengers/vehicle mitigation measure.

Analysis contained in the 1989 EA/PER indicated that the average daily traffic on FAS 419, FAS 420, and FAP 78 had increased since the mine became operational. On FAS 420 traffic volumes rose significantly (40%) from 1985 to 1987. Additionally, the accident rates for each of these roads were found to be generally above the statewide average for similar type roads.

Finally, the East Side EA/PER indicated SMC had made progress toward achieving the 3.0 passenger/vehicle mitigation, but that the goal had not yet been met. SMC requested relief from the mitigation measure via the East Side Amendment, however, the Decision Notice did not grant the request for relief. Additional mitigation was prescribed which required SMC to achieve compliance with the 3.0 goal prior to January 1, 1990. However, SMC employees living within 2 miles of the mine site would not be included during the calculation of vehicle occupancy rate.

Table 3.8-7 indicates actual traffic volumes calculated by the Montana Department of Transportation on the major access corridors leading to the mine during the 10-year timeframe from 1980 to 1990.

Table 3.8-7 Average Daily Traffic: FAS 419, FAS 420, FAP 78

| Access | Years ——————————————————> | | | | |
|---|---|---|---|---|---|
| Route | 1980 | 1987 | 1988 | 1989 | 1990 |
| FAS 419 | 355 | 440 | 500 | 552 | 600 |
| FAS 420 | 236 | 540 | 327 | 365 | 383 |
| FAP 78 | 1,160 | 1,200 | 2,095 | 2,500 | 2,390 |

1991 2000 tpd Amendment

Currently, SMC employs approximately 364 persons at the mine complex. The majority of these people live in the Stillwater County area and commute to work via either FAS 419, FAS 420, or FAP 78. However, as of March 31, 1991, 29 employees lived in Carbon County Montana which lies adjacent to Stillwater County. Additionally, approximately 50% of the employees listed in the "other" category (Table 3.8-8) also reside in Carbon County. The use of FAP 78 and other rural dirt

roads connecting Red Lodge (Carbon County) and the Stillwater Mine has not been analyzed in past permitting documents. Data supplied by the Montana Department of Transportation indicates that use on the of FAP 78 between Red Lodge and Roscoe has increased over the last 3 years. Some portion of this increase is attributable to the operation of the Stillwater Mining Company.

Table 3.8-8 Residence Area for Stillwater Mining Company Employees (3/31/91)

| | |
|---|---|
| Town of Columbus | 54 |
| Rural Stillwater County | 132 |
| Absarokee | 130 |
| Stillwater County Total | 316 |
| Red Lodge | 29 |
| Other | 19 |
| Total | 365 |

Currently SMC is in compliance with mitigation contained in both the Record of Decision (1985) and the Decision Notice (1989) concerning traffic reduction. These mitigation measures required that SMC reach an average of 3.0 passengers per vehicle by January 1, 1990. SMC has not only reached this goal, but exceeded it.

SMC has again requested relief, via the current amendment,from the mitigation measure aimed at mine traffic reduction. This is a result of SMC employee concerns raised during the scoping effort for this analysis. SMC has indicated that it may be an infringement upon the civil rights of their employees for the regulatory agencies to restrict the use of state and county roads.

It should be noted that FAS 419 is planned for upgrading from the junction of FAP 78 to the Stillwater Mine. Currently, bridge reconstruction is taking place near Fishtail, Montana. A portion of the project cost is being provided by the Stillwater Mining Company via the Hard Rock Economic Impact Plan.

## 3.9 Cultural Resources

The area involved in this proposed amendment has previously undergone extensive on-the-ground cultural resource surveys, and literature reviews. The results of these efforts may be found within the 1985 EIS for the Stillwater Project (Chapter III, page III-87), and the 1989 East Side EA/PER (Chapter IV, page 37). These documents are hereby incorporated by reference. If the reader seeks additional information related to cultural resource considerations within the project area, please refer to these documents. No sites are expected to be encountered.

# CHAPTER 4 - ENVIRONMENTAL CONSEQUENCES

## 4.0 Introduction

This chapter discloses the potential impacts of each of the alternatives described in Chapter 2. The intent of this chapter is to provide the scientific and analytical basis of the comparison of alternatives (Chapter 5) and the agencies' conclusions (Chapter 6). The discussion in this chapter includes the environmental impacts of the alternatives including the company's proposal's adverse environmental effects which cannot be avoided should the proposal be implemented, the relationship between short-term use of man's environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources. This chapter also includes a summary of the mitigation measures that would be required for the company's proposal and the other alternatives considered in the analysis.

## 4.1 Tailing Impoundment Construction and Operation

The tailing impoundment construction and operation has been described in detail in the original and amendment permit applications, and the 1985 Environmental Impact Statement. The impoundment has functioned essentially as designed with a few operational modifications.

The impoundment is designed to permanently store the fine fraction of mill tailing. The coarse fraction, which comprises the majority of the mill tailing, is physically segregated by cycloning, and hydraulically placed as backfill into previously-mined areas. The backfilled tailing "sand" is necessary to provide mining access to the ore. Not all of the mill tailing is suitable for use as backfill. The coarse fraction is relatively pervious, and drains to an adequate working platform within an acceptable time following hydraulic placement. The fine fraction, being less pervious, requires impoundment in a surface facility. Most cut-and-fill mining operations use only the sand fraction of tailing as backfill; that is, only particles larger than 200 mesh (U.S. Standard Sieve = 0.074mm or 0.0029 inches) are segregated and placed as backfill. However, SMC uses considerably finer material for backfill. Particles larger than 325 mesh (U.S. Standard Sieve = 0.043mm or 0.0017 inches) are segregated for backfill, and particles less than 325 mesh are slurried to the impoundment.

The metallurgical grind required for mineral recovery controls the particle size distribution of the mill tailing, and subsequently controls the percentages of the mill tailing that can be segregated for use as backfill or must be deposited in the impoundment. Presently, the metallurgical grind provides about 93 percent of the coarse fraction tailing for required backfill volumes, and additional material must be crushed to supplement the backfill sand. This requirement is met operationally by diluting the ore feed to the mill with waste rock (about 10 percent by weight). The metallurgical grind and

the waste rock supplemented for sand presently results in 38-40 percent of the total mill tailing being deposited in the tailing impoundment.

Milling started in March of 1987. The operation to date has produced about 1.3 million tons of ore, and the tailing impoundment contains about 600,000 tons of saturated fines. The impoundment embankment is being constructed by the downstream method of sequential raising. Unlike water impoundment structures, tailing dams can be constructed in stages due to the slow rate of filling. Downstream construction is the most stable method of tailing dam construction (compared to centerline or upstream construction), and is generally considered applicable for impoundments subject to seismic probability, or impoundments with impervious foundations that are unable to minimize ponded water levels. The present impoundment has been constructed to Stage 2; the dam crest elevation is 5,080 feet above sea level, maximum height is about 110 feet, maximum Stage 2 storage capacity is 2.3 million cubic yards of tailing, and the tailing surface will cover 33 acres in the year 2002 at projected filling rates.

Some construction modifications have occurred that vary from the original preliminary engineering design work published in 1986. The design modifications were approved as final engineering reports, as-built construction reports, or permit amendment.

The most substantial variation from the preliminary engineering design occurred during construction of the initial (Stage 1) embankment. At that time, it was determined that the permitted upstream, or inside slope of the dam at 1.6h:1v was too steep to effectively prepare the foundation and place the liner. The upstream slope was subsequently constructed at 2h:1v, resulting in an extension of the downstream toe. Because of the location of the existing toe dike, and the future construction stages with 2h:1v slopes on both the upstream and downstream dam faces, the final permitted elevation of the dam would be limited to 5,111 feet above sea level. The original permitted elevation of 5,102 would have allowed an additional lift, if necessary, before the slope of the dam coincided with the slope of the toe dike. The operational modification of flattening the upstream dam face resulted in better foundation preparation and liner placement, and an increase in the ultimate permitted dam elevation from 5,102 feet to 5,111 feet above sea level. The modification also precluded any future expansions within the limits of the existing toe dike.

During construction of the Stage 2 embankment expansion, the toe dike was extended on the west side to intercept and divert a 68-acre drainage above the tailing impoundment. This extension and diversion reduced flood storage requirements in the impoundment and justified the elimination of an operational spillway.

Stage 2 embankment construction encountered a tight spot in the area of the truck shop building on the north side of the embankment. A retaining wall and subsequent embankment lifts at 1.5h:1v were implemented in order to avoid relocation of the truck shop during operations.

Following removal of surface facilities, the affected portion of the dam flank would be backfilled to achieve the permitted 2h:1v reclamation slopes.

The need for additional material required for backfill volumes was identified and permitted with Amendment 005 - East Side Expansion. Original metallurgical bench testing and material balance estimated that 65 percent of the mill tailing could be used for backfill and the remaining 35 percent would be impounded. However, the finer grind necessitated for metallurgical recovery has resulted in less coarse tailing available for backfill and more fine tailing being impounded. The increased fine fraction of mill tailing being slurried to the impoundment, and the generation of additional fines by the processing of waste rock to supplement sand backfill requirements results in a slightly increased rate of tailing deposition and a corresponding reduction in total ore production and impoundment life.

Reclamation contours for the tailing impoundment surface were revised with Amendment 005. The original permit specified a dome in the middle of the impoundment to direct precipitation runoff radially away from the reclaimed surface. The revised permit specifies that the impoundment surface will be backsloped from the impoundment crest to route runoff away from the dam slopes and toward diversions on the western open end of the impoundment.

### 4.1.1 Environmental Consequences of Impounded Tailing

The existing tailing impoundment, and modifications resulting from the company's proposal and other alternatives being evaluated by the agencies, have environmental consequences that are similar for all potential actions, as well as consequences that are unique to a particular course of action. Geotechnical consequences that are relatively similar for all impoundment scenarios being considered include effluent seepage, liner degradation, and self-weight consolidation of the impounded tailing mass. Examples of environmental impacts and geotechnical issues that are unique to a particular impoundment action include relative impoundment stability, material balances, flood plain intrusions, equipment limitations, and filter compatibility of construction and reclamation materials.

### 4.1.2 Geotechnical Issues and Environmental Consequences Common to All Potential Impoundment Actions

The issues of effluent seepage, liner failure and self-weight consolidation of the tailing mass, and the environmental consequences that may result are relatively common to all the potential impoundment actions being evaluated. The consequences related to these issues would range proportionally with the size of the impoundment. For example, the impounded tailing mass for all actions being considered would range between 3.5 million tons and 5 million tons.

Tailing effluent seepage would occur during the life of the impoundment and for a period of time following closure. Tailing effluent seepage is controlled by the low permeability of the 100-mil HDPE synthetic liner, and to a lesser extent by the tailing mass. The relatively pervious foundation is considered to have negligible influence on impoundment seepage. In other words, any quantity of seepage that passes the liner would be easily carried by unsaturated flow in the pervious foundation.

The impounded tailing fines, also technically referred to as slimes, are segregated as cyclone overflow and slurried to the impoundment at a pulp density of 14 percent solids. At the given pulp density, the slurry contains more than 17 times the volume of water than the volume of solids. The non-plastic solid particles settle out of the slurried suspension rapidly, allowing cleared effluent to be available for decantation and recycle at the mill. The slurried method of deposition and lined foundation cause the sedimentated tailing to be saturated to super-saturated at all times. During normal operations, the impounded tailing is covered by an average of two feet of water.

Seepage of tailing effluent through the synthetic liner can occur by permeation and by flow through defects.

The synthetic liner prevents fluid flow through the liner, but water can permeate the synthetic liner by vapor transmission. It has been estimated that permeation can account for seepage of 0.02 gpm for as long as the tailing mass is saturated, assuming an equivalent liner permeability of $1 \times 10^{-13}$ cm/sec and a permeability of the tailing slimes of $5 \times 10^{-6}$ cm/sec. The seepage due to permeation could account for about 31 gallons per day, or approximately 11,000 gallons per year. However, it is believed that the phenomenon of permeation and the associated phase changes from liquid to vapor results in distillation of the effluent. Therefore, the seepage volume due to permeation would not contain the dissolved chemical constituents of concern that are measurable in tailing impoundment water.

Fluid flow through liner defects was simulated for the 100-mil HDPE liner at the East Boulder project by assuming that defects in liner welds and punctures reduced the overall equivalent permeability of the liner to $1 \times 10^{-12}$ cm/sec. The average permeability of the liner/tailing system can be shown to be $8.5 \times 10^{-9}$ cm/sec, resulting in a seepage rate of 0.22 gpm. The seepage due to fluid flow through liner defects under tailing could account for approximately 317 gallons per day, or 116,000 gallons of tailing effluent per year.

Liner defects in areas that are covered by ponded effluent can contribute greater flows than areas that are covered by tailing fines, as the low permeability of the tailing mass impedes flow to the defect. At an average ponded depth of two feet of effluent above sedimentated tailing, approximately one acre of liner is exposed to unimpeded fluid flow through defects. Assuming a conservative standard defect of a 1/8-inch diameter hole per acre, the unimpeded flow through the liner area under

ponded effluent can be estimated to be 0.26 gpm. The seepage due to fluid flow through defects under ponded effluent could account for 375 gallons per day or 137,000 gallons per year.

The total estimated seepage rate due to permeation and fluid flow through defects can be estimated to be 0.5 gpm over the majority of the life of the impoundment, and for some time after deposition until equilibrium and steady state seepage conditions are reached. The estimated annual seepage volume of 263,000 gallons is insignificant when compared to the approximately 537 million gallons of effluent that are annually slurried to the impoundment at present production rates (about 4 parts per million lost to seepage). However, given the wide range of variables and assumptions, and the theoretical level of current research, any attempt to predict seepage flow through the synthetic liner can be viewed with skepticism.

Based on the chemical constituents of the tailing effluent, a drastic loss of tailing effluent over a period of time would be required to measurably affect the quality of groundwater and surface water resources in the area. It is important to note that most flotation tailing impoundments are unlined facilities that are built on pervious foundations, and are designed to leak. The SMC impoundment is unique in both the relatively innocuous quality of the tailing impoundment water and that it is a lined facility.

Monitoring for seepage includes impoundment piezometer readings, downgradient wells that are checked for water level and water quality changes, and daily observation of process water flow rates and balance. None of these monitoring systems have detected any evidence or effect of seepage from the impoundment.

Deterioration and degradation of the liner would occur over the long term, but it is anticipated that eventual failure of the liner would occur after operations and reclamation. Liner failure can be assumed to be gradual, and subsequent dewatering of the tailing mass can be assumed to be distributed over a period of time. It is estimated that the fine particle size distribution and ultimate consolidated density will result in the majority of the saturated volume being retained in the tailing mass. Published data on deposits of similar mineralogy and size distribution indicate that the tailing mass will retain about 78 percent of its saturated volume under gravity drainage, while yielding about 22 percent of its saturated volume. At an ultimate impounded mass of 3.5 million to 5.0 million tons, the eventual draindown following liner failure would range from 67 million to 96 million gallons.

Self-weight consolidation of the tailing will occur throughout the depositional life of the impoundment, and during and after reclamation. Consolidation will result in an increased average density and a reduction in volume. Consolidation of the tailing mass will cause settlement and depression of the surface.

The proposed method of bulldozing the tailing surface to effect the required reclamation gradient is impractical, given the fine particle size distribution of the tailing slimes and saturated conditions. In addition, the high specific retention of the material will likely limit the effectiveness of attempts to dewater the top of the tailing mass, and surficial desiccation will likely not provide the bearing strength necessary to access the tailing surface with reclamation equipment.

Reclamation access will probably require placement of filter fabric and geonet ahead of an advancing structural cap of waste rock. The final thickness of the cap will be dependent on the required bearing strength of the surface and the degree of consolidation and resulting settlement that will control the ultimate post-reclamation contours.

Preliminary engineering studies on metallurgical bench test tailing have indicated that the material consolidates rapidly (coefficient of consolidation, $C_v$ = 2400 ft$^2$/year). The projected degree of consolidation at closure is high, and the remaining settlement due to primary consolidation and surcharge (waste rock cap weight) consolidation is projected to be minimal, at about 1.5 percent of the deposited thickness. Follow-up studies that involved surveyed pond volumes and known deposited tonnages indicate that the initial stages of deposition have behaved as predicted, based on increasing average dry densities due to self-weight consolidation with depth.

The level of engineering testing and incorporation of consolidation and settlement data into the reclamation proposal of the SMC impoundment surface matches or exceeds present industry standards. However, the projections must be considered optimistic and preliminary. Numerous variables preclude accurate prediction of ultimate consolidation and settlement. Metallurgical bench test models may not accurately represent the behavior of a 5-million-ton prototype. Depositional irregularities can cause variable response throughout the impoundment. Operational modifications, exemplified by the finer mill grind required for metallurgical recovery, can alter ultimate conditions.

The consequences of underestimating ultimate settlement would include an inability to sustain the required reclamation gradient, subsequent precipitation recharge and saturation of the tailing mass and cap materials, and vegetative failure. Given the strict construction specifications for the reclamation cap, the unknowns associated with the bearing strength, degree of consolidation and settlement rate of the tailing mass, and the potential omission of final engineering analyses of the actual tailing mass at closure, it is anticipated that the proposed reclamation of the tailing surface has a marginal probability of success.

### 4.1.3 Geotechnical Issues and Environmental Consequences that are Unique to the Tailing Impoundment Alternatives Being Evaluated

The company's proposal and the reasonable alternative actions that are being evaluated have issues and consequences that are unique to the action. The geotechnical issues relating to the

alternative actions include relative impoundment stability, material balances, floodplain intrusion, equipment limitations and filter compatibility of construction and reclamation materials.

4.1.3a Tailing Impoundment Alternative 3a, No Action

With the no-action alternative, production would continue at 1,000 tpd, and the staged development of the impoundment would continue as permitted; 2h:1v downstream slopes and an eventual crest at elevation of 5,111 feet.

Production at the present rate of 1,000 tpd would fill the impoundment to the 3.5 million ton capacity in 22 years, approximately at the end of the year 2013. During this period, a total of 9.2 million tons of ore would be produced and development would result in surface disposal of 4.6 million tons of waste rock.

Essentially all of the development waste rock would be used by the end of the project and no permanent waste rock storage and dump reclamation would be anticipated. Most of the waste rock would be used in dam construction; other uses of significant quantities of waste rock include sand tailing supplement for backfill, miscellaneous facilities construction and reclamation.

Stability analyses for the ultimate permitted impoundment indicate that a minimum factor of safety of 1.8 exists for the long-term static condition and a factor of safety of 1.3 exists for the pseudostatic (seismic potential) condition. These factors of safety are considered to be well above the minimum acceptable factors of safety recommended by the U.S. Army Corps of Engineers and adopted as design criteria by SMC. Minimum acceptable factors of safety are 1.5 for static conditions and 1.0 for pseudostatic (seismic potential) conditions. A factor of safety of 1.0 suggests that a structure has an equal probability of failing or remaining stable under given conditions. A minimum static factor of safety of 1.5 is considered by the industry in general to be necessary and reasonable, given that analyses consist of empirical modelling and the potential hazards of failure deserve less than equal odds of occurring. A minimum pseudostatic factor of safety of 1.0 is generally considered appropriate because of the low probability of occurrence of the design seismic event.

Structural damage or failure could be induced by the design flood events. Original baseline studies demonstrated that the one-half Probable Maximum Flood (PMF) would peak about 4 feet above the base of the toe dike, and subsequent erosion could cause structural damage to the embankment. The occurrence of the full PMF may or may not be sufficient to cause failure of the dam, but damage to the embankment was determined to be insignificant compared to regional damage from the full PMF.

Failure of the SMC embankment due to mass instability or flood damage could result in the release of about 3.5 million cubic feet (26 million gallons) of ponded water, if failure occurred during the operating life. The tailing mass itself has some internal shearing strength and would not be expected to flow. Total failure of the dam after reclamation could cause long-term mobilization and distribution of the tailing by wind and water erosion.

4.1.3b Tailing Impoundment Alternative 3b, Company Proposal

SMC has proposed to increase the daily production rate to 2,000 tons, and revise the remaining stages of tailing impoundment construction to increase storage capacity and impoundment life. The embankment crest would be raised 14 feet from the permitted elevation of 5,111 feet to an elevation of 5,125 feet. The ultimate tailing elevation would be increased 19 feet from the permitted elevation of 5,102 feet to an elevation of 5,121 feet. In addition to raising the dam height, the downstream slope of the dam would be constructed and reclaimed at 1.6h:1v so that the final slope of the dam would coincide with the slope of the existing toe dike.

The company's proposal would increase the capacity of the impoundment from 3.5 million tons to 5.0 million tons of tailing. The ultimate capacity would allow production of 13.2 million tons of ore. The life of the impoundment would be 17 years, through the year 2008, at a 2,000-tpd production rate.

Development and disposal of 6.6 million tons of waste rock would be associated with production of 13.2 million tons of ore. The majority of the waste would be used in dam construction, sand tailing supplement for backfill, facilities construction and reclamation. An estimated 623,000 tons of waste rock would require permanent storage and dump reclamation.

Overall stability of the proposed impoundment would be less than the permitted impoundment. Stability analyses for the proposed impoundment indicate that a minimum factor of safety of 1.5 exists for the long-term static condition and a factor of safety of 1.1 exists for the pseudostatic (seismic potential) condition. The static factor of safety of 1.5 is equal to the minimum acceptable factor of safety, and the pseudostatic factor of safety is slightly greater than the minimum acceptable design criteria. The analyses suggest that the proposed expansion and modification of the tailing impoundment may be approaching the limit of prudent engineering. However, the analyzed stability meets U. S. Army Corps of Engineers and industry standards and the analytical assumptions are reasonable and acceptable.

Structural damage or failure of the impoundment due to flood potential would be unchanged by the company proposal. The final stage of construction is designed to incorporate the existing toe dike into the permanent slope; therefore, there would be no downstream extension of the final dam

toe. The one-half PMF flood would cause erosion of the dam toe and the full PMF may cause failure of the embankment.

Reclamation of the 1.6h:1v dam slope is proposed as armoring with selected coarse waste rock. The proposal varies from the permitted reclamation of a 2h:1v dam face by exchanging questionable vegetative productivity for long-term stability. If properly constructed, it is anticipated that the steep armored dam face would have much greater resistance to the erosional forces of precipitation runoff and wind than a somewhat less steep vegetated dam face. Proper construction of the final dam face would require filter compatibility between the riprap and the embankment construction material. The proposed use of available coarse waste rock does not meet all filter criteria, and piping of embankment fines would likely occur during precipitation runoff events. Due to the extreme thickness of the base, in this case the dam construction materials, erosion by piping would not be a threat to the structural stability of the dam. However, piping of embankment fines could result in localized channeling of runoff, potential minor slumping of armor and deposition of alluvial fines at dam toe discharge points.

The environmental consequences of filter incompatibility would be minor, but if a localized problem developed, repair of the slope would be extremely difficult or impracticable. Slopes of 2h:1v are considered the maximum gradient for operation of construction equipment, and operation is limited to crawler tractors in one direction - parallel to the slope. In addition to the uneven traction of a riprapped surface, the extreme gradient of the proposed slope would preclude any remedial reclamation efforts.

4.1.3c Tailing Impoundment Alternative 3c, Partial Approval

The partial-approval alternative would allow the company to expand production and milling facilities to accommodate a 2,000-tpd production rate without modification of the permitted tailing impoundment. The impoundment would continue to be constructed in stages to a final crest elevation of 5,111 feet and final downstream slopes on the dam face at 2h:1v.

Phased increase of production to 2,000 tpd would fill the tailing impoundment to the permitted 3.5 million ton capacity in 12 years. Production of a total 9.2 million tons of ore would continue through the year 2003.

Essentially all of the 4.6 million tons of development waste rock would be used in dam and facility construction, sand tailing supplement for backfill, and reclamation.

The staged construction of the embankment would be unchanged, and the analyzed stability factors of safety would remain well above the minimum acceptable criteria.

Structural damage or failure due to flood potential would be the same as the no action alternative or the company proposal. The existing toe dike face would be incorporated into the final reclaimed slope. The one-half PMF flood would reach the dam toe and cause some erosion and structural damage. The full PMF may cause failure of the embankment.

4.1.3d Alternative 3d — Modified Tailing Impoundment

Approval of the company's proposal with modification would enable SMC to increase production and processing facilities to accommodate a mining rate of 2,000 tpd. Tailing impoundment expansion to the proposed crest elevation of 5,125 feet would be allowed to increase storage capacity and impoundment life. The proposed staged construction would be modified to maintain 2h:1v downstream dam face slopes during operation and reclamation. The construction of the dam face at 2h:1v rather than 1.6h:1v would cause a downstream extension of the dam toe, and the existing toe dike would be buried by the final stage of construction. Reclamation of the dam face would remain as permitted; that is, soil covered and revegetated.

The tailing impoundment expansion would allow deposition of 5.0 million tons of tailing and production of 13.2 million tons of ore. At a phased incrementation to an eventual production rate of 2,000 tpd, the tailing impoundment capacity would suffice for 17 years of operation, through the year 2008.

Most of the 6.6 million tons of development waste rock would be used to build the larger, modified embankment. Additional waste rock requirements for facilities construction, sand tailing supplement for backfill, and reclamation would exceed the projected available waste rock. Therefore, an additional borrow source would have to be developed to provide an estimated 470,000 tons of construction material.

Stability analyses have not been performed for the modified embankment. Construction of the embankment at 2h:1v would require that the volume of the embankment contain 15 percent more construction fill than the company proposal of a 1.6h:1v downstream slope on the embankment. Although the comparison of stability is not directly proportional to embankment volume, all other parameters affecting stability are equal and the larger modified embankment would have greater factors of safety under both long-term static and pseudostatic conditions. It is presumed that the mass stability of the modified embankment would exceed minimum acceptable criteria.

Construction of the ultimate embankment downstream slope at 2h:1v would bury the existing toe dike. The modified dam toe would extend a maximum of 62 feet and an average of 55 feet toward the Stillwater River. Supercritical flows from the one-half PMF flood would reach about 10 feet above the base of the dam, and extensive erosion and structural damage would be expected. The

probability of total failure with the occurrence of the one-half PMF or full PMF flood events would increase significantly with this alternative.

Cumulative Effects of Tailing Impoundment Alternative

Since neither Chome Corporation of America nor International Platinum operations are reasonably foreseeable, no cumulative effects are expected.

## 4.2 Water Resources

### 4.2.1 Hydrologic Consequences of the Alternatives Being Considered

The project is currently permitted to develop and produce about 9.2 million tons of ore, based on the 3.5 million ton capacity of the tailing impoundment. To date, development has resulted in 1.7 million tons of waste rock and the production of 1.3 million tons of ore. Ongoing production and development would result in larger discharges of adit water due to groundwater interception by mine openings.

The company's proposal would result in the production of 13.2 million tons of ore and an associated 6.6 million tons of waste rock. Operational discharge of mine water has been estimated by SMC to eventually be 789 gpm of which 700 gpm would be due to groundwater inflow. The average steady state groundwater flow of 700 gpm would continue after operations as permanent groundwater interception and discharge.

The company estimate of 700 gpm of ultimate groundwater flow into the mine is considered to be optimistic. The mine is presently at about 26 percent of the required development and has produced only 10 percent of the proposed ore. Groundwater intercept predictions of both the original EIS (December, 1985) and the East Side Expansion environmental assessment (Amendment 005, December 1988) were exceeded early in the life of the project. Therefore, an estimated increase of ultimate steady-state groundwater inflow to 700 gpm from the present average of 500 gpm may be unrealistically low.

The estimated discharge of 789 gpm may be reasonable during operations because groundwater inflows can be slowed by grouting and excess water intercepted by mine openings can be incorporated into project water consumption and balance. However, ultimate and permanent groundwater inflows and discharge will likely exceed the estimated operational discharge of 789 gallons per minute. Grouting techniques can be effective in obstructing flow paths and reducing groundwater flow volumes, but grouting is a partial and temporary reduction of long term groundwater flows. The viscosity of grout precludes pumping to any appreciable distance or into extensive fracture systems. Mining-induced stress field changes and subsequent destressing will

fracture grout and grouted rock mass, particularly during the late stages of mining and the period of post-mining convergence.

The extent of development required to access ore will directly affect the amount of water-bearing structural intercept and groundwater flow into mine openings. Underground development is necessarily ahead of production, particularly given that the SMC project is essentially in the start-up phase. Existing development is believed to have already dewatered major structure to steady state discharge levels. The relatively shallow depth of the mine workings below surface and the recognized groundwater connection to surface recharge systems controls the probability of future groundwater intercept. Development of laterals, cross-cuts and raises above and below the existing developed levels would not be expected to intercept water-bearing structure that has not been previously encountered. However, the extension of development to the east and west of existing levels would be expected to intercept water-bearing structure at a rate and volume proportional to that experienced during previous development.

The Stillwater project has about 12,000 feet of strike length developed for production access. The amount of available ore reserves within the developed strike length is unknown. Given the variability of ore grade mineralization and low extraction ratios (stoping extent in the ore plane) experienced on the west side, and the relatively consistent and narrow width of the ore-bearing zone, it is estimated that existing development may not be sufficient to support access to the permitted production of 9.2 million tons of reserves. Similarly, the proposed production of 13.2 million tons of ore will likely require east and west extension of present development, and the intercept of additional water-bearing structure and increased steady state groundwater flows can be anticipated.

The intersection of water bearing structure with east and west extension may not decrease as development proceeds farther into the mountains. Overburden above mine openings would be as much as 3,000 feet on the lower levels and as little as 50 feet in the stoping crown pillars. The considerable geologic deformation in the Stillwater Complex and the inflow conditions that have been experienced to date indicate that water bearing structure beyond present development would probably have connection to surface recharge sources.

Production zones can potentially contribute to groundwater inflow and discharge. Most groundwater has been encountered in development openings. However, stoping is permitted to within 50 feet of the surface and the fractured crown pillars are expected to result in hydraulic conduits for surface water recharge. Stopes that are mined to within 50 feet of the surface could result in groundwater flow through pervious sandfilled production zones. In addition, the proposed increase in production will create about 10 times the volume of backfilled voids that exist today, and at least minor groundwater inflows in these areas could be expected to contribute to permanent discharge.

The original EIS (December 1985) was accurate in the assessment that groundwater flows in the fractured bedrock system would be impossible to predict. Unknowns with regard to ore plane mineralization, ore reserves, development requirements and fracture location will continue to preclude accurate anticipation of groundwater flow into mine openings during future operations and after closure. However, a range of ultimate and permanent groundwater discharge volumes can be estimated by using known discharge volumes, existing and ongoing monitoring data, and projected material balance quantities. A conservative estimate of 1900 gpm may ultimately and permanently discharge as steady state groundwater flow into mine workings, assuming the present to proposed ore and waste rock volumes, and the developed strike length and extraction ratios required to produce 13.2 million tons of ore.

The proposal to expand tailing impoundment capacity to accommodate production of 13.2 million tons of ore would result in permanent steady state groundwater flow into underground mine openings and subsequent adit discharge of 700 - 1900 gallons per minute. Surface water resources in the area will probably be impacted by the altered groundwater system. Groundwater flow through natural bedrock systems will increase when the mine openings are connected to surface water recharge sources by fractures. Stoping to within 50 feet of the surface will create a cone of depression and drawdown for area groundwater, and will likely impact surface water resources in local areas.

The anticipated increased groundwater flows into mine openings would have little affect on operational or post-operational water quality. Groundwater drawdown and surface water recharge of fractured crown pillars above stoping zones may affect water quality to some degree. The movement of groundwater through stopes backfilled with tailing and along the stope and rib pillar boundaries in the mineralized plane could result in discharge of dissolved metals.

Alternative 4a, No Action

Groundwater interception and discharge from existing development and projected mining and development of 9.2 million tons of ore would result in permanent flows that could range from 500 to 700 gpm.

Alternative 4b, Company's Proposal

Groundwater interception and adit discharge from the proposal to develop and mine 13.2 million tons of ore would result in permanent steady-state flows that could range from 700 to 1,900 gpm.

Alternative 4c, Advanced Treatment

Under the advanced treatment alternative, groundwater interception and permanent adit discharge rates could range from 500 gpm to 1,900 gpm, depending on the development and production of 9.2 to 13.2 million tons of ore.

4.2.2 Water Quality

Certain aspects of the existing facility and proposed expansion will be similar under each of the Alternatives considered. These consequences will be considered in this section before the more detailed Alternatives analyses are presented in subsequent sections.

Runoff and Sediment Control. Under all of the alternatives considered, additional construction activities would surfically disturb soils on both sides of the Stillwater River. The removal of the ground surface would result in temporary increases in runoff and erosion. While there would be an increase in erosion, the amount of sediment reaching the Stillwater River would be minimal.

In anticipation of the new Stormwater Regulations, SMC has instituted a surface water management plan using diversion ditches and catch basins upgradient of the Stillwater River. These structures are designed to be zero discharging under normal precipitation events. SMC will be required to obtain a Stormwater permit and monitor any discharge after Stormwater regulations are adopted by the DHES.

Spills and Pipeline Ruptures. Possible spills from fuel tanks or chemical stock piles could impact groundwater. If these spills were to occur, impacts would be greatly reduced due to the presence of concrete containment pads beneath the storage areas.

All alternatives include 4-6 pipelines crossing the Stillwater River. Rupture of these lines would result in several hundred to several thousand gallons of material being discharged before shut-down of equipment would occur.

All pipelines crossing the Stillwater River are enclosed in a steel containment vessel which is designed to route spilled material to a spill containment pond located on the east side of the river. The containment vessel is equipped with moisture sensors which would trigger alarms at the mill control center. The containment pond has the capacity to handle the spilled material until shut-down of affected circuits. SMC has developed a Spill Prevention and Response Plan to address this potential situation.

Tailings Impoundment and Mill Facility. From a water quality impacts perspective these facilities are similar under all the alternatives. The reason for this is that the mill and impoundment are zero-discharging facilities. That is, no discharge of process water to surface or groundwater occurs from either of these structures. Process water is recycled through the mill circuit with adit water being used to supplement process water when necessary.

The 100-mil HDPE impoundment liner is unique in that it is used with flotation tailings. Seepage from the impoundment is considered inconsequential. Tears or improperly sealed seams may have an adverse impact on groundwater; however, downgradient monitoring wells would detect such a leak before significant impacts could occur.

The impoundment is designed to contain the probable maximum flood event, excess tailings, and three feet of freeboard. Therefore, it is unlikely that any storm event would overtop and/or breach the impoundment embankment.

Under federal and state New Source Performance Standards (NSPS), SMC could apply for discharge of process water from these facilities since it is located in a net precipitation zone, that is, more rain falls than evaporates. Any discharge would have to meet federal technology-based (Best Available Technology Economically Achievable, or BAT) standards and state water quality standards. However, since SMC only discharges treated adit water, both federal and state NSPS are met or exceeded for the mill process water.

Septic System and Drainfield. Any water supply or wastewater disposal system that serves 25 or more people daily is defined as public system and must submit plans and specifications to the DHES for approval prior to construction, alteration or extension (ARM 16.20.401 et seq.). Wastewater systems must conform to DHES standards set forth in Circular No 84-10. Septic systems designed and operating to these specifications are considered to be applying secondary treatment.

The existing drainfield was approved in December 1986 by the DHES. SMC would be required to submit an engineered design for expanding the existing system if the amendment were approved by the agencies.

It is estimated that a drainfield designed for 525 people would add approximately 2.6 and 0.35 pounds per day of nitrogen and phosphorus, respectively, or twice the amount existing in the soil. Based on the depth to groundwater, and transmissivities of the underlying aquifer it is qualitatively assumed that impacts would be minimal.

Water Quality Standards and Impact Analyses

Both state (DHES) and federal (EPA) agencies have standards that apply to surface and groundwater discharges. These standards incorporate both numeric (water quality-based) and technology-based standards. Numeric standards and nondegradation are designed to protect human health and aquatic life by limiting the increase in concentration of certain harmful substances. Technology-based standards, when applicable, specify the degree of waste water treatment considered appropriate for surface water discharges.

The DHES is responsible for implementing sections of the Federal Clean Water Act under delegated authority from EPA. Montana has adopted EPA's Water Quality Criteria (EPA, 1986) for surface water which lists numeric standards that protect human health and aquatic life. Nondegradation standards are designed to prevent incremental (less than numeric standard) increases in these parameters that, taken together with other incremental increases, would cause exceedance of numeric standards.

Montana surface water quality standards also require that industrial wastes receive as a minimum, treatment equivalent to best practicable control technology currently available (BPCTCA), or, the equivalent of secondary treatment (ARM 16.20.631). Montana BPCTCA incorporates by reference Federal treatment standards as defined in 40 CFR Subchapter N which includes a Platinum Ores subcategory. These standards apply to any discharge of a pollutants to surface water (see Glossary for definition of discharge).

Montana has also promulgated groundwater standards pursuant to the Montana Water Quality Act (WQA). These standards also contain numeric standards and nondegradation provisions. Groundwater rules do not contain technology-based treatment standards except those defined in the Water Quality Act (MCA 75-5-303) for nondegradation. Since the most common beneficial use of groundwater is for drinking water, Montana has adopted EPA's Maximum Contaminant Levels (MCL) as numeric standards designed to protect human health. Nondegradation applies to those parameters which have MCL's, or any constituent that may adversely affect beneficial uses.

Impacts to surface and groundwaters in the following sections are calculated through the use of loading analysis. Loading analysis estimates the increased mass or load of constituents (metals or nutrients) in a receiving water when the discharge from the proposed action is added. The results are reported as concentration, that is, milligrams per liter (mg/L). The results are presented along with the applicable numeric standard which is also expressed in mg/L for comparative purposes.

A number of uncertainties are inherent in this type of analysis. It is assumed that the quantity of ambient and discharge water is exactly known and mixing is instantaneous and complete. It is also assumed that the exact value of each parameter in the equation is known. However, the value is often

below the analytical detection limit (denoted with a less than "<" symbol). In these cases, the actual analytical detection limit is used in the calculation. Finally, no attempt has been made to calculate the amount of attenuation that would occur in both soil and groundwater. These processes are well known and do result in some removal of nutrients and metals.

In each case, conservative assumptions are made involving these uncertainties. Therefore, loading analysis tends to overestimate the impacts of the proposed discharge.

Impacts to groundwater are based on dissolved metals. This procedure involves passing the sample volume through a filter (0.45 microns) in the field before acidifying the sample. Particulate material is retained on the filter and discarded. Surface water analyses are based on an unfiltered sample and expressed as total recoverable metals.

Actual surface water discharge would take place under the terms of an MPDES permit. The permit would specify limits based on either a technology based limit, such as for total suspended sediment (TSS), or water quality based limit, such as for nutrients and metals. Actual effluent limits would be developed after the BHES ruled on the petition. It would be SMC's responsibility to provide any additional treatment necessary, prior to discharge, to meet these standards. Violation of these effluent limitations would result in enforcement action by the DHES.

Total dissolved solids, ammonia, nitrate, chromium, copper, iron, lead, manganese, nickel and zinc are included in the petition and analyzed for each alternative since the concentration of these parameters is greater than the ambient concentration in the Stillwater River. Total dissolved solids, nitrate, chromium, and lead are included in the groundwater portion of the petition and are analyzed along with the other metals.

Parameters not included in the petition include cadmium, arsenic, mercury, beryllium and silver, although cadmium and mercury are specified in the MPDES permit. The concentration of cadmium in the adit water is lower than ambient surface and groundwater concentrations and therefore direct discharge does not constitute degradation. Arsenic, mercury and beryllium are not included since they are not present in the ore body based on geochemical sampling (SMC, 1991a). Silver is slightly elevated in the ore body but is limited by extremely low solubilities. These predictions have been confirmed through sampling of the adit water and analysis at extremely low detection limits by both SMC and the agencies.

For the purpose of analyzing surface water impacts to the Stillwater River, average and low flow values were determined from USGS Gaging Station (06202510) located above Nye Creek. The low flow was determined from the 7-day, 10-year low flow, as required in ARM 16.20.703. The average and low flow estimates are 367 and 33 cubic feet per second (cfs), respectively. For

comparative purposes the current SMC discharge is 500 gpm (1.1 cfs) and would increase under the proposed action to 789 gpm (1.7 cfs).

Groundwater dilution estimates were derived from observed nitrate concentration in monitoring wells (MW-12A, 13A, & 15A) during March through May 1991 when the SVR percolation ponds were in use (SMC, 1991a). Based on this information, it is estimated that 500 gpm of adit water will mix with 88 gpm of groundwater between the percolation ponds and the downgradient monitoring well. Additional dilution and mixing are qualitatively assumed before the effluent plume leaves the SMC permit boundary.

Indirect impacts to surface water may result after adit water mixes with groundwater in the vicinity of the SVR percolation ponds and this groundwater eventually mixes with surface water. The degree and location at which this mixing occurs is unknown. However, a conservative estimate may be obtained if it is assumed that this mixing occurs immediately downstream of the SMC property. For the purpose of estimating these impacts, it is assumed that 588 gpm of groundwater and adit water will mix with the Stillwater River below the percolation ponds.

4.2.2a Alternative 4a - No Action

Under this alternative the MPDES surface water permit would be renewed based on the existing effluent limitations since no new or enlarged source of pollution would exist. Permit limits in the existing discharge permit are summarized in Table 4.2-1. Based on the adit water quality

Table 4.2-1 Summary of Effluent Limits in SMC Surface Water Discharge Permit

| | Effluent Limitations - Concentration (mg/L) | |
|---|---|---|
| Parameter | Daily Average | Daily Maximum |
| Cadmium | 0.0010 | 0.0015 |
| Copper | 0.022 | 0.033 |
| Lead | 0.010 | 0.015 |
| Mercury | 0.00005 | 0.00008 |
| Zinc | 0.02 | 0.03 |
| Iron | 0.20 | 0.30 |
| Nickel | 0.01 | 0.015 |
| Total Suspended Solids (TSS) | 20 | 30 |
| Oil and Grease | 10 | N/A |

pH shall be maintained between 6.3 and 8.4 standard units.
Phosphorus - There shall be no increase in total phosphorus between SMC-1A and SMC-2.
Nitrogen - Total nitrogen at SMC-2 shall be no greater than 1 mg/L, unless total nitrogen at SMC-1A is greater than 1 mg/L (natural exceedance).

Source: MPDES Permit No. MT-024716

(Table 3.2-6) SMC would have to provide additional treatment to remove total suspended solids (TSS) from an average of 99 to the permit limit of 20 mg/L. Metal concentrations would also be concurrently reduced since most metals are generally associated with particulate material.

An efficient, cost-effective method for reducing particulate material may be the addition of rapid sand filtration units after clarification. These units could produce an effluent that consistently meets the established criteria. Alternatively, SMC may be able to achieve the specified limits by the use of settling ponds prior to clarification. Metal concentrations may be reduced to below ambient levels and therefore degradation would not occur for these constituents. However, these technologies would have little or no effect on ammonia and nitrate concentrations.

The surface water loading analysis for this alternative is present in Table 4.2-2 and is based on discharge limits specified in the existing permit (Table 4.2-1). Limited degradation would occur for ammonia, nitrate and copper at low flow. Surface water quality standards would not be exceeded for any parameter and the 1.0 mg/L instream standard for nitrate would not be exceeded.

Table 4.2-2 Projected Surface Water Quality from Direct Discharge for Alternative 4a

| Parameter | Existing Water Quality | MPDES Effluent Limits | Projected Water Quality Low Flow | Average Flow | Surface Water Quality Standard |
|---|---|---|---|---|---|
| Total Dissolved Solids (TDS) | 37 | NEL | 46 | 38 | 250 |
| Total Suspended Solids (TSS) | – | 10 | – | – | – |
| Ammonia | <0.1 | NEL | 0.2 | 0.1 | 1.8 |
| Nitrate | 0.26 | NEL | 0.70 | 0.30 | 10 |
| Chromium | <0.001 | NEL | 0.002 | 0.001 | 0.055 |
| Copper | 0.002 | 0.022 | 0.003 | 0.002 | 0.003 |
| Iron | 0.12 | 0.02 | 0.12 | 0.12 | 0.3 |
| Lead | 0.003 | 0.01 | 0.003 | 0.003 | 0.0004 |
| Manganese | <0.005 | NEL | – | – | 0.05 |
| Nickel | <0.005 | 0.01 | 0.005 | 0.005 | 0.013 |
| Zinc | 0.011 | 0.02 | 0.011 | 0.011 | 0.027 |

NEL - No effluent level specified in current MPDES permit; projected water quality is based on effluent concentration (total recoverable) without treatment.

The current rate (500 gpm) and practice of groundwater disposal would be maintained under this alternative. Table 4.2-3 presents the existing ambient groundwater and effluent quality, and groundwater standards. These levels represent the average ambient concentrations downgradient of the Stillwater Valley Ranch (SVR) percolation ponds. Except for chromium in the effluent, the concentrations of the other dissolved metals are below the ambient amounts. The highest nitrate concentration in monitoring wells below the SVR percolation ponds is 5.4 mg/L.

Table 4.2-3 Projected Groundwater Quality from Discharge to SVR Percolation Ponds for Alternative 4a

| Parameter | Existing Water Quality | Effluent Quality | Groundwater Standard |
|---|---|---|---|
| Total Dissolved Solids (TDS) | 167 | 200 | – |
| Ammonia | <0.1 | 1.8 | – |
| Nitrate | 3.48 | 8.42 | 10 |
| Chromium | 0.0023 | 0.004 | 0.05 |
| Copper | <0.01 | 0.0006 | – |
| Iron | <0.03 | 0.03 | – |
| Lead | 0.002 | 0.0004 | 0.050 |
| Manganese | <0.02 | 0.02 | – |
| Nickel | <0.01 | <0.005 | – |
| Zinc | 0.013 | 0.01 | – |

Discharge to percolation ponds provides minimal treatment for nutrients but does effectively remove particulate material and hence metals. Ammonia may be lost through volatilization or adsorbed to clay minerals. Nitrate may be converted to nitrogen gas via denitrification under anaerobic conditions and lost to the atmosphere.

Under the existing MPDES permit, SMC has been granted a mixing zone for groundwater within the property boundary. Under groundwater rules, standards may be exceeded in mixing zones (ARM 16.20.1010). It is likely that nitrate concentrations in groundwater within the property boundary may increase up to the adit water discharge concentration which may exceed 10 mg/L at times. Under the groundwater rules, SMC is entitled to a mixing zone within the limits of their property boundary (ARM 16.20.1010). Groundwater standards may be exceeded in mixing zones.

Off-site (below SVR ponds) nitrate concentrations in groundwater are qualitatively assumed to increase but would be substantially diluted so that the MCL (10 mg/L) would not be exceeded. The concentration of dissolved chromium in adit water ranges from less than 0.001 to 0.016 mg/L (average 0.004 mg/L). The MCL for chromium is 0.05 mg/L. Therefore, numerical standards would not be exceeded on or off the SMC property.

Impacts to downstream surface water from the current SVR discharge are presented in Table 4.2-4. These impacts are based on dissolved metals since particulate material is effectively removed by percolation. Under these conditions, there would be increases in ammonia and nitrate concentrations under low and average flow conditions. Metal concentrations are maintained or improved due to dilution.

Table 4.2-4 Projected Surface Water Quality Changes from Discharge of Adit Water to SVR Percolation Ponds

| Parameter | Existing Water Quality | Effluent Quality | Projected Water Quality Low Flow | Projected Water Quality Average Flow | Surface Water Quality Standard |
|---|---|---|---|---|---|
| Total Dissolved Solids (TDS) | 37 | 200 | 43 | 37 | 250 |
| Ammonia | <0.1 | 1.8 | 0.2 | 0.1 | 1.8 |
| Nitrate | 0.26 | 8.42 | 0.54 | 0.28 | 10 |
| Chromium | <0.001 | 0.004 | 0.001 | 0.001 | 0.055 |
| Copper | 0.002 | 0.0006 | 0.002 | 0.002 | 0.003 |
| Iron | 0.12 | 0.03 | 0.12 | 0.12 | 0.3 |
| Lead | 0.003 | 0.0004 | 0.003 | 0.003 | 0.0004 |
| Manganese | <0.005 | 0.02 | 0.006 | 0.005 | 0.05 |
| Nickel | <0.005 | <0.005 | 0.005 | 0.005 | 0.013 |
| Zinc | 0.011 | 0.01 | 0.011 | 0.011 | 0.027 |

Elevated levels of nitrate, sulfate and TDS indicate groundwater impacts at locations other than the SVR ponds are reflective of the current practice of land application. The lack of increase of other constituents indicates that this is an effective treatment method. SMC presently land applies the waste stream that is composed entirely of adit water. The application typically occurs during the six-month growing season. The application can occur for up to eight months.

The land application can be defined as the controlled application of wastes onto the land surface to achieve a specified degree of treatment through physical, chemical, and biological processes within the plant-soil-water matrix. The system employed at SMC is typically named a slow-rate system where wastewaters are applied in an irrigation manner.

There are two general constituents of concern in the wastewater from SMC. The first constituent is the nitrogen species. Most nitrogen in the wastewater is in the form of nitrates; nitrogen is also in the form of ammonia. The ammonia form of nitrogen can be lost through volatilization, taken up by the crop or adsorbed by the clay minerals in the soil. Nitrate can be taken up by the vegetation, or converted to nitrogen gas via denitrification in anaerobic zones and lost to the atmosphere.

The second area of concern is the metal constituent. Trace metals removal is a complex process involving the mechanisms of adsorption, precipitation, ion-exchange, and complexation. The major concern is the potential for accumulation in the soil profile, and subsequent transport into vegetation.

EPA has developed guidelines for the land application of municipal sludge to agricultural crop land (EPA, 1983). Land application is a valuable disposal alternative used by many publicly owned

municipal treatment facilities. Because of the concern for uptake by plants, EPA has developed recommended application rates for sludge which are often high in metals and other toxic constituents.

For comparative purposes, loading estimates to soil were developed based on the current application rate (500 gpm) to 59 acres for 6 months of the year. These estimates are presented along with EPA recommended application rates for soils with Cation Exchange Capacities (CEC) less than 5 (the lowest category) in Table 4.2-5. Nitrogen requirements vary between 45 to over 312 pounds per acre depending on the plant species. Iron and manganese are trace elements required for plant growth.

Table 4.2-5 Application Rate in Pounds per Acre at SMC and EPA Recommended Cumulative Limits for Agricultural Croplands

| Parameter | Current Rate of Application | EPA* Guideline |
|---|---|---|
| Nitrogen* | 184 | – |
| Cadmium | 0.003 | 4.4 |
| Chromium | 0.24 | – |
| Copper | 0.54 | 125 |
| Iron | 30.4 | – |
| Lead | 0.13 | 500 |
| Manganese | 0.52 | – |
| Nickel | 0.37 | 125 |
| Zinc | 0.37 | 250 |

* Ammonia and Nitrates
Source: EPA-625/1-83-016 (EPA, 1983)

As long as soil pH is maintained at 6.0 to 6.5 and application rates remain below EPA recommended rates, metal will remain in the soil and not affect groundwater. Any long-term impacts to beneficial uses of these soils would be through plant phytotoxicity. Copper, zinc, and nickel are the elements of most concern to plant phytoxicity. As long as soil pH is maintained in this range, these metals should not be taken up by the vegetation in amounts that would cause impairment to plant growth.

4.2.2b Alternative 4b - Company's Proposal

Under this alternative adit discharge would increase by average of 289 gpm from 500 to 789 gpm. The increase in blasting would increase nitrogen compounds in discharge water. SMC proposed to maintain the level of treatment described in Alternative 4a.

To project the increased concentration of ammonia and nitrates, the average load of ammonia and nitrate was doubled and the resulting concentration was determined based on 789 gpm. The current average load of ammonia and nitrate are 10.8 and 50.5 pounds per day, respectively, based on

concentrations of 1.8 and 8.42 mg/l and 500 gpm. The projected concentration is 2.3 and 10.6 mg/L for ammonia and nitrate, respectively. These values will be used to project water quality impacts.

Other factors may effect nitrogen concentrations. The additional 289 gpm would be a result of inflow to the adit of groundwater which is essentially free of nitrogen compounds. This would tend to dilute the nitrate concentration. Based on the existing nitrate and adit discharge data a weak negative correlation exists between nitrate concentration and flow (r= -0.23). This data indicates that as additional flows are encountered nitrogen compounds are reduced. However, SMC has indicated that they will eliminate the current practice of pumping freshwater (groundwater) into the adit for drilling purposes. Instead, they will use clarified adit water. Since clarification does not affect nitrate concentrations, this practice may serve to increase nitrate concentration of adit water.

The concentration of metals is expected to remain at the current levels. Metal loads may increase slightly due to the increased volume of water. Projected water quality will be based on current concentrations and projected water volumes.

This alternative evaluates the surface and groundwater concentrations requested in the petition. If granted, these in-stream concentrations would be developed into MPDES effluent limits and incorporated into SMC's discharge permit. Table 4.2-6 identifies the proposed effluent limits based on the levels presented in the petition. The concentrations of TSS, copper, iron and lead in the

Table 4.2-6 Projected Surface Water Quality from Direct Discharge Under Instream Values Requested in Petition

| Parameter | Existing Water Quality | Effluent Quality | Proposed[1] MPDES Effluent Limits | Low Flow | Average Flow | SMC Requested Limits | Surface Water Standard |
|---|---|---|---|---|---|---|---|
| Total Dissolved Solids | 37 | 200 | 200[2] | 46 | 38 | 200 | 250 |
| Total Suspended Solids | – | 99 | 20[3] | – | – | – | – |
| Ammonia | <0.1 | 2.3 | 2.3[2] | 0.2 | 0.1 | 0.4 | 1.8 |
| Nitrate | 0.26 | 10.6 | 10.6[2] | 0.81 | 0.31 | 2 | 10 |
| Chromium | <0.001 | 0.015 | 0.07 | 0.005 | 0.001 | 0.005 | 0.005 |
| Copper | 0.002 | 0.028 | 0.02 | 0.003 | 0.002 | 0.003 | 0.003 |
| Iron | 0.12 | 1.85 | 1.6 | 0.20 | 0.13 | 0.02 | 0.03 |
| Lead | 0.003 | 0.007 | 0.003 | 0.003 | 0.003 | – | 0.0004 |
| Manganese | 0.005 | 0.003 | 0.46 | 0.030 | 0.007 | 0.03 | 0.05 |
| Nickel | 0.005 | 0.023 | 0.1 | 0.010 | 0.005 | 0.01 | 0.013 |
| Zinc | 0.011 | 0.02 | 0.08 | 0.015 | 0.011 | 0.015 | 0.027 |

1. Based on instream values requested in Petition (SMC, 1991a).
2. Based on average adit water concentration after conventional treatment.
3. Based on BAT (Best Available Treatment Technology) not subject to modification by petition.

effluent exceed the permit limits, therefore, SMC would need to apply additional treatment before direct discharge into the Stillwater River. Conventional treatment options are readily available and discussed under Alternative 4a.

The projected concentration in groundwater and surface water below the SVR percolation ponds are presented in Tables 4.2-7 and 4.2-8, respectively.

Table 4.2-7 Projected Groundwater Quality from Discharge to SVR Percolation Ponds

| Parameter | Existing Water Quality | Effluent Quality | Projected Water Quality | SMC Requested Limit | Groundwater Standard |
|---|---|---|---|---|---|
| Total Dissolved Solids | 167 | 200 | 178 | 300 | – |
| Ammonia | <0.1 | 2.3 | 0.2 | – | – |
| Nitrate | 3.48 | 10.6 | 6.3 | 8 | 10 |
| Chromium | 0.0023 | 0.004 | 0.003 | 0.02 | 0.05 |
| Copper | <0.01 | 0.0006 | 0.0062 | – | – |
| Iron | <0.03 | 0.03 | 0.03 | – | – |
| Lead | <0.002 | 0.0004 | 0.0014 | 0.01 | 0.05 |
| Manganese | <0.02 | 0.02 | 0.02 | – | – |
| Nickel | <0.01 | <0.005 | 0.008 | – | – |
| Zinc | 0.013 | 0.02 | 0.012 | – | – |

Table 4.2-8 Projected Surface Water Quality from Discharge of Adit Water to SVR Percolation Ponds

| Parameter | Existing Water Quality | Effluent Quality | Projected Water Quality | | SMC Requested Limits | Surface Water Standard |
|---|---|---|---|---|---|---|
| | | | Low Flow | Average Flow | | |
| Total Dissolved Solids | 37 | 200 | 46 | 38 | 200 | 250 |
| Ammonia | <0.1 | 2.3 | 0.2 | 0.1 | 0.4 | 1.8 |
| Nitrate | 0.26 | 10.6 | 0.81 | 0.31 | 2 | 10 |
| Chromium | <0.001 | 0.004 | 0.001 | 0.001 | 0.005 | 0.055 |
| Copper | 0.002 | 0.006 | 0.002 | 0.002 | 0.003 | 0.003 |
| Iron | 0.12 | 0.03 | 0.12 | 0.12 | 0.2 | 0.3 |
| Lead | 0.003 | 0.0004 | 0.003 | 0.003 | – | 0.0004 |
| Manganese | <0.005 | 0.02 | 0.005 | 0.005 | 0.03 | 0.05 |
| Nickel | <0.005 | 0.005 | 0.005 | 0.005 | 0.01 | 0.013 |
| Zinc | 0.011 | 0.01 | 0.011 | 0.011 | 0.015 | 0.027 |

Land application rate for nitrogen compounds would increase from 184 to 368 pounds per acre. Metal loading to soil would essentially remain the same for cadmium but increase for the other metals of concern (Table 4.2-9). Based on these analyses, nitrogen application may exceed plant growth requirements and increased leaching of nitrogen through the soil may occur. Metal

concentrations in the soil column would remain well below recommended criteria. Concentration of dissolved metal in groundwater would not be expected to increase from land application.

Table 4.2-9 Application Rate in Pounds Per Acre Under Alternative 4b and Percent Increase Relative to No Action

| Parameter | Pounds per Acre | Percent Increase |
|---|---|---|
| Nitrogen* | 368 | 100 |
| Cadmium | 0.003 | 0 |
| Chromium | 0.44 | 83 |
| Copper | 0.85 | 57 |
| Iron | 54.4 | 79 |
| Lead | 0.20 | 54 |
| Manganese | 0.88 | 69 |
| Nickel | 0.67 | 81 |
| Zinc | 0.58 | 56 |

* Includes ammonia and nitrate

Impact to Surface and Groundwater From Granting the Petition.

Based on the analyses of Alternative 4b, the concentrations requested by SMC in the petition are achievable in groundwater and surface water after discharge to percolation ponds. Applicable water quality standards would be maintained for class B-1 surface water and Class 1 groundwater. Direct discharge to surface water would require additional treatment before MPDES permit limits are achievable. SMC would be responsible for providing treatment before discharging.

The following section contains an analysis of the impacts of granting the petition on beneficial uses in surface and groundwater. Impacts are presented and compared to ambient concentrations developed under the no action alternative.

Total Dissolved Solids (TDS). TDS is a measure of the amount of dissolved salts in freshwater. Under low flow conditions concentrations will increase seven percent from 43 to 46 mg/L in surface water. Groundwater concentrations will increase from 167 to 178 mg/L. Increased TDS concentrations are primarily a result of increased calcium, sodium and sulfates in the adit water.

The surface water standard is 250 mg/L and applies to chlorides and sulfates. This standard is based primarily on unfavorable physiological and taste concerns, and increased corrosion for industrial uses. There are no groundwater standards for TDS. Beneficial uses should not be affected by the projected increase in TDS. The requested concentration in the petition is 200 mg/L in surface and groundwater.

Ammonia. Increased ammonia concentrations in surface water would not be measurable under the company's proposal even though nitrogen loads are projected to double. Ambient concentrations in both surface and groundwater are below detectable limits. Since ammonia is lost through volatilization and readily utilized by plants, it is likely ammonia concentration in surface water would only increase through direct discharge.

The freshwater acute and chronic concentrations of ammonia for protection of salmonids species is 20.5 and 1.8 mg/L at a pH of 7.0 and 10 degrees (C). Ammonia becomes more toxic at warmer temperatures and higher pH. Direct discharge would result in a maximum concentration of 0.1 mg/L and therefore aquatic species should not be affected. The requested concentration in the petition is 0.4 mg/L for surface water.

Nitrate. Nitrate concentrations in the Stillwater River are projected to increase from 0.70 to 0.81 mg/L with direct discharge, and 0.54 to 0.81 mg/L from discharge to percolation ponds under the company's proposal. Groundwater concentrations of nitrate would increase from 3.5 to 6.3 mg/L. Nitrate concentrations are highly variable and would occasionally exceed this amount in the groundwater. Significant dilution with area groundwater and the Stillwater River are expected to dampen these fluctuations so that concentrations off the SMC permit boundary would not exceed the requested concentration or the standard. SMC has requested concentrations of 2 and 8 mg/L in surface and groundwater, respectively.

The drinking water MCL for nitrate is 10 mg/L. Nitrates only become toxic under conditions in which they are, or may be, reduced to nitrite. Nitrite can be fatal to children under the age of 3 months due to the physiological susceptibility of this age group. High nitrates concentrations are common in domestic water supplies, particularly in rural areas resulting from improperly maintained domestic septic systems or agricultural practices.

Nitrate in surface water may cause an increase in photosynthetic algae. Generally algal growth in freshwater is limited by phosphates. During certain times of the year, excessive growth of algae may lead to secondary problems such as: undesirable aesthetics, tastes and odors; interference with water treatment; increases in biological oxygen demand. Nitrate and nitrite are not known to have any toxic effect on aquatic organisms.

Typically, algal growth in freshwater rivers and streams is thought to be limited by bio-available phosphorous. The optimal ratio of phosphorous to nitrogen for plant growth is 10:1 and was the basis for the 1.0 mg/L in stream limit in the original permit. Recent information indicates that algal growth increases at much lower levels of phosphorus and nitrogen. Algal growth will continue to increase up to a point, beyond which other natural processes will work to reduce the amount of algal biomass in the system (Bahls, 1991). This point is difficult to estimate and will vary from stream to stream depending on other factors, such as: temperature, stream gradient, water level

fluctuations and other macro and micronutrient availability. These factors may be operating in the Stillwater River to limit algal growth.

Due to the inherent variation in natural systems, these factors will occasionally get out of balance and algal blooms (excessive growth) will occur. Since these factors are difficult to predict and until site-specific information is developed, the WQB considers any surface water with total inorganic nitrogen in excess to 1.0 mg/L as having an impaired beneficial use (aquatic life) (Water Quality Bureau, 1986).

Chromium. Chromium may be present in water in either of two oxidation states, chromium(III) or chromium(VI). Chromium(III) is the most common form and is considered an essential nutrient for human health in small quantities. Chromium(VI) is less common and generally occurs in manufacturing or industrial process waste. Industrial categories that generate chromium(VI) wastes include chrome plating, paints and other pigments production (such as toners in laser printers and photocopiers), tanning and electronics.

Limited sampling at SMC indicates that Chromium(III) is the dominate species in adit water. Calculable increases in chromium concentrations may result form the proposed expansion, but it is likely that these increases would not be measurable. The concentration of chromium in adit water is 0.004 and 0.015 mg/L for dissolved and total recoverable, respectively. The highest projected concentration would be in surface water (0.005 mg/L) under direct discharge.

The current drinking water MCL for chromium is 0.05 mg/L, however, EPA has proposed raising the MCL to 0.1 mg/L. The freshwater chronic criteria are 0.011 and 0.055 for chromium (VI) and (III), respectively. SMC has petitioned the BHES for limits of 0.005 and 0.02 mg/L for surface and groundwater, respectively. The projected increases should not adversely affect human health or aquatic organisms.

Copper. Ambient copper concentrations in the Stillwater River would increase from 0.002 to 0.003 mg/L with direct discharge under either alternative 4a or 4b. Discharge to percolation ponds would not affect copper levels and may actually decrease levels in the river due to dilution.

Aquatic organisms are highly sensitive to copper concentrations particularly in waters with low hardness. The freshwater chronic criterion for copper is 0.003 mg/L. There are no known human health impacts associated with copper. EPA has proposed a copper concentration of 1.3 mg/L for public water supplies based on unfavorable taste characteristics. Technology-based discharge criteria (BAT) for copper are 0.15 and 0.30 mg/L average and mximum daily, respectively, for the Platinum mine subcategory (40 CFR Subpart K). Therefore, water-quality based criteria would apply.

The petition requests 0.003 mg/L in surface water. SMC would likely have to provide additional treatment to achieve MPDES discharge limits.

Iron. Iron concentrations in the Stillwater River would increase from 0.12 to 0.20 mg/L with direct discharge under the company's proposal. Surface water concentrations would decrease slightly with continued discharge to percolation ponds. To achieve the proposed discharge limit under any alternative, SMC would have to remove iron from the adit water through additional treatment.

Iron is the fourth most abundant element on earth and is an essential trace element required by both plants and animals. The freshwater criterion for iron is 1.0 mg/L and the recommended level in drinking water supplies is 0.3 mg/L. The petition requests 0.2 mg/L and would not adversely affect human health or aquatic organisms.

Lead. The ambient concentration of lead is 0.003 mg/L in surface water and less than 0.002 mg/L in groundwater. Since the ambient concentration of lead in the Stillwater River exceeds the standard (0.0004 mg/L) no increase in concentration would be allowed. SMC originally requested a surface water limit for lead in the petition based on data that indicated lead levels in the river were below standards. Based on subsequent analyses by the WQB and SMC the ambient concentration exceeds the standard.

Under the Alternative 4b the proposed MPDES effluent limit for lead would be lowered from 0.010 to 0.003 mg/L. Based on data collected before SMC began operations, and current data, the lead concentration in the Stillwater River has decreased. Impacts from discharge to percolation ponds indicated that lead concentrations in the river would be maintained or slightly reduced. Lead concentrations in adit water are less than in groundwater, therefore groundwater should not be impacted.

The current MCL for lead is 0.05 mg/L, however, EPA has proposed reducing this level to 0.015 mg/L. Technology-based discharge criteria (BAT) for lead are 0.3 and 0.6 mg/L average and maximum daily, respectively, for the platinum mine subcategory (40 CFR Subpart K). Therefore, water-quality based criteria would apply. SMC has requested a groundwater level of 0.01 mg/L for lead.

Manganese. There is currently no MPDES limit for manganese. Under the company's proposal direct surface water discharge would result in an increase from less than 0.005 to 0.03 mg/L manganese during low flow periods. SMC has requested an instream limit of 0.03 mg/L. There would be no difference in concentration in surface water between Alternative 4a and 4b by discharge to percolation ponds. Manganese concentrations in groundwater may slightly increase but the actual impact would not be measurable since the groundwater concentration is less than detection limits.

Manganese is an essential growth nutrient for plants and animals. Manganese is not known to adversely affect aquatic organisms. The surface water standard of 0.05 mg/L is based on human health and is primarily intended to prevent staining and objectional tastes.

Nickel. Nickel concentrations in ambient water are below the detection limit. The requested ambient concentration of 0.01 mg/L would result in an increase in concentration from under 0.005 to a maximum of 0.01 mg/L if direct surface water discharge were utilized. Surface water concentrations would be maintained through discharge to percolation ponds.

The freshwater chronic criterion for nickel is 0.040 mg/L for aquatic organisms. The human health criterion is 0.013 mg/L and there is no drinking water MCL. The human health criteria is based on long-term exposure to nickel.

The human health criterion is based on evidence that some forms of nickel may be a carcinogen when inhaled. However, limited testing to date has not demonstrated this property for ingestion of nickel compounds (U.S. Public Health Service, 1988). Small amounts of nickel have been demonstrated to be essential for normal growth and reproduction of some animals. The requested limit is below the human health criterion.

Zinc. Adit water concentrations of zinc are slightly elevated relative to ambient concentrations. Direct discharge would increase zinc concentrations from 0.011 to 0.015 mg/L under low flow conditions in the Stillwater River. Surface water concentrations would not be affected under any alternative if discharge to percolation ponds were maintained.

Freshwater chronic criterion for zinc is 0.027 mg/L. This concentration will not be exceeded and therefore no adverse impacts should result from this amount. Technology-based discharge criteria (BAT) for zinc are 0.75 and 1.5 mg/L average and maximum daily, respectively, for the Platinum mine subcategory (40 CFR Subpart K). Therefore, water-quality based criteria would apply.

Summary of Impacts of Granting the Petition (Alternative 2 — 4b)

The preceding section has evaluated the impacts to surface water from direct discharge and after discharge to the SVR percolation ponds. Water quality impacts to groundwater have also been evaluated.

Direct discharge to the Stillwater River under the company's proposal (Alternative 4b) would increase the concentration of nitrate, chromium, iron, manganese, nickel, and zinc under low flow (7-day, 10-year flow) if the petition were granted. Discharge during average flows would result in increased concentrations of nitrate and manganese. Surface water concentrations of other parameters

may be affected but would not be detectable. In any case, surface water quality standards would not be exceeded. Human health and aquatic organisms would not be adversely impacted.

The Stillwater River may be indirectly impacted due to discharge of adit water to the SVR percolation ponds and from land application. Land application of clarified adit water may exceed the assimilative capacity of the existing vegetation which would increase nitrates in groundwater and surface water. Metals are effectively removed by land application and would not exceed adverse amounts in the soil column or groundwater under either alternative.

Total dissolved solids and nitrate concentrations in the Stillwater River would increase slightly during low and average flows under the company's proposal as a result of discharge to percolation ponds. Metal concentrations would not be affected.

The average concentration of lead in the Stillwater River exceeds chronic criteria. Lead concentration would not increase under the company's proposal. Since lead is associated with particulate material, LAD application is an effective removal process. Additional treatment to remove particulate material would be necessary before direct surface water discharge. SMC would not be required to treat effluent to reduce lead to below ambient levels (ARM 16.20.618(2)(h)(iv)).

Although lead concentrations exceed chronic standards, bioassay tests conducted by SMC on Stillwater River water indicates that cutthroat trout are not being negatively impacted. Bioassay tests expose subject organisms to actual river water for 96 hours at conditions that simulate river conditions.

Total dissolved solids (TDS), ammonia, nitrate, chromium and nickel concentrations in groundwater are projected to increase within the SMC property boundary under the proposed action. None of these increases would exceed standards or negatively impact any present or foreseeable beneficial uses. With the exception of nitrate, groundwater concentrations outside of the SMC property boundary are not expected to significantly increase above background.

4.2.2c Alternative 4c — Advanced Treatment

SMC has proposed three advanced water treatment options in the petition that would maintain ambient water quality. Adit water, or a portion of it, would be directed to a treatment plant before discharge to either surface or groundwater. The degree of treatment necessary would vary depending on whether SMC chose to continue disposing to a land application system (percolation and irrigation) or to surface water.

Additional analyses were not conducted under this alternative since water quality projections under the No Action Alternative 4a and discussed in Chapter 3 (Affected Environment) would be

maintained if the petition were denied. Alternative 4b analyzes the water quality impacts associated with increased production and granting the petition at the levels requested by SMC.

The degree of water treatment that would be necessary would be based on nitrate removal. Metals would likely be reduced to ambient levels, or below, by pretreatment of the adit water for removal of solids. Pretreatment would be required for each of the proposed treatments. All three treatments could technically achieve the desired degree of treatment for nitrate (MDSL and USFS, 1990).

All of the advanced treatment options would generate a brine by-product that would require disposal. During operations this material may be placed in the tailings impoundment for permanent disposal. However, this material may preclude recycling of adit water and therefore necessitate modification in the current mill circuit that would require discharge of additional effluent to land application or surface water. After closure these wastes may have to be shipped off site for disposal. SMC would be required to submit plans for disposal including waste characterization under the Resource Conservation and Recovery Act (RCRA).

### 4.2.3 Alternative 3 — Tailing Impoundments

Water quality options would not impact any tailing impoundment configurations.

### 4.2.4 Alternative 5 — Company Proposal with Modifications

Alternative 5 contains modifications to SMC's monitoring plan which would use lower, more sensitive detection limits for metals in surface and groundwater, and require additional groundwater monitoring locations. Soils would be monitored to assess metal accumulation and removal efficiency. The company's monitoring program would also be modified to include a biological monitoring program for the Stillwater River.

An expanded chemical monitoring program would ensure that off-site ambient water quality is maintained. Allowable ambient concentrations would be determined by the BHES. If off-site ambient concentrations were exceeded, SMC would be required to provide treatment, or modify operations to achieve compliance with ambient concentrations.

The expanded biological monitoring would document changes in periphyton community structure and growth characteristics. However, due to the inherent variation in natural stream community dynamics, changes in periphyton populations alone, would not prompt additional water treatment.

### 4.2.5 Cumulative Impacts

The impacts of the proposed expansion have been evaluated relative to the existing operation and discussed in the preceding sections. Incremental increases in the concentration of nutrients and some metals would result from the proposed expansion unless an advanced treatment option is selected (Alternative 4c). These increases would be less than numerical water quality standards and would not have significant impacts, either individually or cumulatively, to human health or aquatic organisms.

Other activities that increase the concentration of nitrates, as well as other nutrients, include domestic septic systems, agriculture, logging and mining. These activities are considered as nonpoint source pollution and are excluded from the nondegradation rules when all reasonable land, soil and water conservation practices have been applied (75-5-306 MCA). Since nitrates are biologically assimilated, numeric water quality standards would not be exceeded as a result of these activities.

Metal concentrations would reasonably be expected to increase as a result of other mining activities within the basin. Any activity that would be considered as a source of groundwater pollution, or a new source of degradation in surface water would be required to petition the BHES for changes in ambient water quality. Projected impacts would be evaluated at that time.

The upper 6.6 miles of the Stillwater River above Wounded Man Creek is listed as moderately impaired for metals, sulfate and pH from historic mining activities (WQB, 1990). The Yellowstone River below the Stillwater River is moderately to severely impacted from suspended sediment and nutrients, primarily resulting from agriculture and municipal sewage. Stream segments are listed as impaired when one or more of the beneficial uses are not fully supported. Discharges from the company's proposal would not significantly impact any beneficial uses or result in further deterioration of these impaired segments.

## 4.3 Soils and Tailing Impoundment Reclamation/Revegetation

Reclamation issues have been addressed in previous environmental reviews by the agencies in 1985 and 1989 (DSL/FS, 1985; DSL/FS, 1989). Environmental consequences on soils should be minor and short term assuming appropriate construction and reclamation methods are employed. Soil impacts are directly related to the amount of area disturbed. Many acres disturbed by previous activities at the project area are being reclaimed as part of SMC's reclamation plan. Limited soil replacement can result in long-term reductions in soil productivity.

Reclamation issues to be investigated in this EA focus on the lack of soil available to reclaim disturbances particularly for the embankment of the tailing impoundment. The regulatory agencies EA interdisciplinary team (IDT) and public scoping identified potential problems with the reclamation

plan as proposed in the amendment as well as the plan currently permitted. Limited soil resources for reclamation are available. Therefore, additional analyses were performed to address the potential for long-term reclamation success due to soil loss on a revegetated 50 percent slope (the current plan).

### 4.3.1 Soil Salvage Review

Soil salvage at the disturbance sites has been limited by the large amount of previously disturbed areas and the presence of large rocks and boulders on the soil surface. Original soil salvage estimates indicated 0-84 inches of soil was suitable for salvage from the major undisturbed soils in the area (Table 3.3.-1). Some salvage loss was anticipated from the presence of large rocks and boulders on the surface of area soils. Salvage depths were also limited by the depth to water table and the depth to bedrock on some soils.

To date, 38,000 lcy of soil have been salvaged from all mine disturbances (see page 4-13A and 4-14 of SMC 1990 Amendment Application). Under the current approved reclamation plan, a total of 39,500 lcy of topsoil was estimated to be available for reclamation of 149.3 acres of mine disturbances (See pages 4-43 through 4-48 of SMC 1988 Amendment Application). These estimates were approved and bonded by the agencies. This equals a replacement depth of 1.6 settled inches of topsoil over previously allowed mine disturbances.

Soil salvage to date has largely been limited to the surface horizons only, or in other words, the classic topsoil layer. Soil salvage practices have improved since the original operating permit was issued to SMC in 1986; the value of subsoils for reclamation growth media has been demonstrated. A soil salvage review is needed on the entire mine site to ascertain the extent that subsoils can be used.

To improve reclamation success, the mining company has been testing alternate growth media such as mine waste rock, tunnel boring machine (TBM) waste rock and tailings. Initial evaluations appear to support the contention that the mine waste products may be blended to produce acceptable growth media.

An aggressive testing and evaluation program needs to be implemented to address the blending of waste rock, tailing, and soil as well as any additional fertilizer and organic amendments to enhance reclamation success in the long term at the mine site. This testing must include the static and kinetic testing to identify the potential for eventual acid production and metals leaching in the case of a pH change over time. Recent research in northern Minnesota indicates that even mine ore with less than half a percent sulfur content can acidify over time (MNDNRC, 1990.)

SMC's use of the TBM has been curtailed so that the amount of that waste product is in doubt. Use of subsoils, especially alluvium and glacial till, would produce better growth media than

mine waste rock or tailings. The use of alluvium and glacial till even with up to 75 percent coarse fragment content by volume would be better than mine waste rock alone. These subsoils would provide additional rooting depth and limit problems with filter compatibility between a replacement topsoil layer and mine waste rock.

The Universal Soil Loss Equation (USDA, 1978) was used to try to predict soil losses on the approved 50 percent (2h:1v) revegetated tailing impoundment embankment slope. The USLE enables users to predict the average rate of soil erosion for alternative land uses and management practices in association with a specific soil type, rainfall pattern, and topography. The predicted losses are compared with given soil loss tolerances for a proposed land use. This comparison can help develop specific guidelines for effective erosion control.

The soil loss equation is: $A = R\ K\ LS\ C\ P$, where

A = is the computed soil loss per unit area, expressed in tons of soil lost per acre per year.

R = is the average annual rainfall, runoff and snowmelt factor for the mine area, obtained from R factors maps prepared by the USDA. R = 60 was used for all computations in the EA.

K = is the soil erodibility factor. This value indicates the ease with which soil particles are detached and floated away by raindrop impact and surface water movement. In the original soil survey for the tailings impoundment area, the Lolo soil series was to be one of the major soils salvaged for impoundment reclamation. It has an erodibility factor of 0.20. This value was arbitrarily used in all comparisons.

LS = The slope length and slope steepness is used to compute a topographic factor. The soil loss increases as the topographic factor increases. The LS factor was interpolated from Table 4-1 in Renard, et al. 1990 depending on slope angle and slope length.

C = The cover factor takes into account the amount of plant canopy cover as well as ground cover due to rocks as well as vegetation. The soil loss decreases as the per cent ground cover increases. Calculations were made for final reclamation success assuming a maximum canopy cover of 50 percent. This is reasonable for ultimate reclamation success on shallow soils and on slopes from 50-62.5 percent. The maximum ground cover value assumed in a stable reclaimed embankment face was assumed to be 60 percent, of which 50 percent is rock fragments. (NOTE: Unacceptable soil losses were found for all soil loss calculations with less than 50 percent coarse fragments.)

P = The supportive practice factors are natural topographic features or range conservation practices that slow runoff to varying degrees. No modifications

to slope shape or surface roughness were used in these calculations. A value of 1 was assumed for all calculations.

T = The equation states that in shallow soils a loss of 2 tons/acre/year is tolerable. If the calculated soil loss exceeds 2 tons/acre/year then either other soil erosion control practices would have to be applied or existing practices would have to be intensified. Twelve inches of soil on an embankment face is assumed to be a very shallow to shallow soil type. The allowable soil loss for a very shallow to shallow soil is 1 or 2 tons/acre/year respectively.

Table 4.3-1 Alternative 3a. Soil Loss Calculations for a 50 percent (2:1) slope with an embankment height of 141 feet. Final reclamation success assuming 50 percent canopy cover, 50 percent rock fragments on the surface, and total ground cover of 60 percent.

| | | USLE FACTORS | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Slope Length maximum | Sloped Acres | R | K | LS | C | P | A | T |
| | | | | tons/ac/YR | | | | |
| 315' | 54 | 60 | .20 | 15.5 | .035 | 1 | 6.5 | 2.0 |
| 200' | 54 | 60 | .20 | 12.1 | .035 | 1 | 5.1 | 2.0 |
| 100' | 54 | 60 | .20 | 8.3 | .035 | 1 | 3.5 | 2.0 |
| 50' | 54 | 60 | .20 | 5.7 | .035 | 1 | 2.4 | 2.0 |

Table 4.3-1 lists the predicted soil loss for the current permitted reclamation plan. The permitted slope length for the embankment face is 315 feet. As permitted and when it is reclaimed, the face will cover 54 sloped acres. The predicted soil loss approached tolerable soil losses when soil with 50 percent coarse fragments in the surface horizon, and slope lengths of 50 feet were used in the calculations. Erosion may limit long-term revegetation success, but would not jeopardize the stability of the tailing impoundment embankment.

4.3.1.1 Alternative 3a No Action

Under this alternative soil salvage and the proposed replacement of salvaged soil would continue as permitted. Replacement depths would equal 1.6 settled inches over 149.3 acres (Table 3.3.2). These replacement depths over mine waste products would not equal the soil depths in undisturbed soils that existed before mining. If it is assumed that soil salvaged from undisturbed acres has to be spread over all acres disturbed by mining, which included a lot of previously disturbed acres, then proposed replacement soil depths should equal approximately half of the depth that existed before mining. The approved plan, according to today's standards, will produce marginal reclamation success.

The embankment would remain as permitted with a height of 141 feet and slope of 50 percent (2h:1v) which is to be revegetated after placement of one foot of soil. Success of the approved embankment reclamation plan would be limited because one foot of replacement soil has not been salvaged and TBM waste may no longer be available for use as a subsoil layer.

4.3.1.2 Alternative 3b Company's Proposal

Under this alternative, soil salvage and the proposed replacement of soil has been increased to 2.0 settled inches over 159.6 acres of disturbance (Table 3.3.2). This increase is still below the depths needed to cover mine disturbances with approximately half of the original soil depth. Although this would produce marginal success, deeper soil replacement would produce greater success.

SMC has proposed to raise the embankment 14 feet to a total of 155 feet and increase the slope to 62.5 percent (1.6h:1v). In addition, the company proposes to rock armor the slope and not revegetate. By increasing the slope to 62.5 percent, the number of sloped acres decreases to 41.6 acres, a total of 12.4 acres less than the current approved plan. Total slope length would be 292 feet which is less than the approved plan length of 315 feet. Rock armor would limit erosion, soil loss and revegetation.

4.3.1.3 Alternative 3c Partial Approval

Under this alternative, production would be allowed to increase to 2,000 tpd, all facilities expansions and disturbances as proposed by SMC could occur, except modification of the tailing impoundment. However, no additional acres would be disturbed before a soil salvage review could be conducted.

Increased biological productivity and lessened impacts to area visuals would be addressed in a modified reclamation plan for the embankment slope. The embankment slope would be a mosaic of rock and soil which would address limiting soil loss by reducing slope length.

4.3.1.4 Alternative 3d Modified Impoundment

Under this alternative, soil salvage and replacement depths would remain the same as in alternative 3b, except that soil would be replaced on the embankment face.

In this alternative, the embankment would be increased to 155 feet in height as in the company's proposed action, but the slope would be maintained at 50 percent (2h:1v). This would increase the number of sloped acres to 62 and increase the slope length to 347 feet. Grass revegetation would be implemented as in the current approved plan.

The soil loss predictions in any year after reclamation would be higher than the currently approved plan, as the only change in the soil loss prediction formula is increased slope length.

4.3.1.5 Proposed Action with Modifications — Alternative 5

Regardless of which option in Alternative 3 is selected, mitigations have been developed.

Mitigation 1 - Soil Salvage review

A soil salvage review is needed because present soil replacement depths are limited and that produces a marginal probability of reclamation success. The review would:

a) try to enhance soil salvage on any additional acres which might be disturbed;
b) inventory subsoils which may become available when mine and mill associated structures are removed at the end of mine life;
c) inventory disturbed soils and other areas where subsoils could be borrowed;
d) be submitted by January 1, 1993 and salvage progress should be updated in annual reports.

This soil salvage review would become the basis for a modified reclamation plan for all mine disturbances.

Soil Mitigation 2 - Alternate Growth Media Review

If soil replacement depths are still marginal after the review, then an aggressive testing and evaluation of mine waste products should be discussed characterizing the long-term desirability of mine waste products as plant growth medium in the rooting zone of revegetated communities such as SMC's present TBM test plots and the toe dike.

The long-term acid producing and metal problems associated with weathering of mine waste products must be reviewed in a study plan which is approved by the agencies. The plan must recommend static and kinetic testing for acid production and metal leaching due to pH changes during the rest of mine life.

Tailing Embankment Slope Length Mitigation

Based upon the soil loss calculation discussed in section 4.3.1, the embankment reclamation plan must be modified to minimize soil loss. The plan should address 1) use of coarse fragments and surface soils 2) reduction of slope length through the use of a mosaic of rock armor and soil. This

mosaic plan would maximize biological productivity while minimizing soil loss to erosion and piping into embankment construction materials.

4.3.2 Cumulative Soil Impacts

Overall soil impacts resulting from this project in conjunction with other CNF projects would be low. No excessive soil erosion is expected to occur which would impact other resources. The cumulative impacts of all local projects would not eliminate any unique soils resources.

4.4 Wildlife

Introduction

During the scoping effort for this project a number of concerns related to wildlife impacts were raised. These are detailed in the Chapter 1 (Sec. 1.7.2) of this document. Through preliminary analysis, the IDT narrowed the focus of wildlife impacts to those species which would most likely be affected by implementation of the company's proposal.

Concerns related to elk impacts were expressed by nearby residents. Apparently fewer elk use the area in and around the Cathedral Mountain Ranch since the mid-1980's. A biologist for the DFW&P has indicated this trend may indeed be taking place. However, the situation may relate more to increased subdivision and subsequent home construction than to operation or expansion of the Stillwater Mine (Stewart 1991, personal communication).

A Biological Evaluation is include in this analysis, it appears as Appendix 1. This document assesses the proposed action's potential to negatively impact threatened or endangered species within the project area. Correspondence received from the USFWS indicates that in accordance with Section 7(c) of the Endangered Species Act of 1973, the following listed, proposed and category 1 candidate threatened or endangered species may be present in the project area.

| Listed Species | Expected Occurrence |
|---|---|
| bald eagle (Haliaeetus leucocephalus) | winter resident, migrant. |
| peregrine falcon (Falco peregrinus) | migrant |

Proposed Species

None

Category 1 Candidate Species

None

### 4.4.1 Alternative 1 No Action

Direct and Indirect Effects

If the no-action alternative were selected there would be no change in the current trend and condition of wildlife resources within the project area. Neither mule deer nor bighorn sheep would experience additional disturbance to their respective winter ranges that differ from what has been previously analyzed by the agencies. The Stillwater bighorn sheep herd would be expected to continue its steady population decline. A recently-completed report indicates that the herd is currently at an all-time population low. Within 10 years the population may be eliminated if this trend continues. However, the deer population would continue to thrive. These animals would occupy the winter habitat of the sheep in the event the herd is eliminated. Competition for forage and space is currently high between these two species.

Selection of the no-action alternative would mean no design or construction changes would take place to the tailing impoundment. Current tailing impoundment construction specifications call for the preservation of the current toe dam face. This structure will be used as the foundation for the impoundment dam during the final phase of construction. This will require that construction equipment place mine waste rock on top of the toe dam in successive lifts. During this construction phase, the bighorn sheep are expected to be displaced from the toe dam area upon which they currently depend for forage. Bighorn sheep will not tolerate any disturbance upslope of their position. Once construction is completed in the area of the toe dam, the sheep would most likely begin to use the area again. It is impossible to predict with any certainty how long reoccupation of the site would require.

Additionally, current reclamation specifications call for the complete revegetation of the impoundment at final reclamation. Recent analysis indicates that this reclamation stipulation may be marginal. Long slopes constructed at a 2h:1v pitch may erode and be less productive if covered solely by vegetation. If this were to occur, bighorn sheep forage would be lost and the sheep negatively impacted.

Fisheries

The structural integrity of this facility would not be changed, consequently the possibility of dam failure would not change. Therefore, no additional impacts would be introduced related to the trout fisheries which exist in the Stillwater River.

Cumulative Effects

Selection of this alternative would prevent the addition of more persons at the mine. Therefore, increased recreational hunting or fishing demands would not take place due to operation of the Stillwater Mine. No other large-scale employment opportunities are foreseen to occur within the Stillwater drainage. Therefore, additional cumulative impacts are not expected at this time.

4.4.2 Alternative 2 Company's Proposal

Direct and Indirect Effects

Changes which would occur due to selection of this alternative, that have the potential to impact area wildlife resources include: 1) modification to the existing tailing impoundment construction, 2) tailing impoundment reclamation specifications, 3) additional 35 acres of ground disturbance, and 4) increased traffic volumes traveling to and from the mine.

The largest potential negative impact to the bighorn sheep would result from changes to the tailing impoundment construction and reclamation. Currently the sheep heavily rely on and utilize the forage on the toe dam. If this alternative is selected, the toe dam would not be immediately eliminated. However, in order to steepen the impoundment dam to a 1.6h:1v slope, lifts of mine waste rock would be placed on top of the toe dam sometime in the near future. When this occurs the sheep are expected to leave the area as long as construction equipment is present. Additionally, the newly-constructed dam face would not be composed of potential sheep forage. Rock armorment is proposed for the impoundment face at final reclamation. This type of impoundment face would be expected to provide security habitat for the sheep, but little forage if any would be provided.

Impacts to the sheep are not expected due to increased traffic at the mine complex. Traffic levels would increase as compared to the current level, however, the impact threshold has already been reached. The sheep would not be able to perceive an increase in traffic volume if the 3.0 passenger/vehicle mitigation measure were applied. Traffic impacts due to vehicle occupancy rates of 2.0 to 2.5 passengers/vehicle would most likely not adversely impact the sheep as long as human-sheep interaction were avoided. This would be accomplished by requiring SMC to continue its internal education program related to sheep-human interactions. Also, the seasonal area restrictions above the mine would be continued. To date, results of this effort have been successful.

The planned additional 35 acres of ground disturbance would not severely impact the sheep herd. Most of this disturbance is planned to occur outside of the core winter range in areas not heavily used by the sheep. Thus, impacts would be minimal.

Mule deer which inhabit the area seem not to be closely tied to a core range. Thus they display more flexibility in their habitat selection. The area in the vicinity of the tailing impoundment is not heavily used by mule deer. Only the ground disturbance planned for the east side of the Stillwater River has the potential to disrupt mule deer use of the area. This impact is related to construction of the proposed visual berm. Once this structure is constructed, snow would be expected to accumulate on the leeward side during the winter months. This would render forage in that area unavailable. However, a large forage base for this species exists within the project area, therefore, impacts are not expected to be more severe. Overall, mule deer are not expected to be impacted by selection of this alternative.

Fisheries

In the event of a catastrophic failure of the tailing impoundment dam, fine particulate material may be incorporated into the Stillwater River. The area downstream of the impoundment serves as an important spawning ground for the trout species which inhabit the Stillwater and Yellowstone drainages. Incorporation of fine sediment into this ecosystem could render these spawning grounds unsuitable for dependent trout species. However, given the low probability of impoundment failure, and the fact that material stored in the impoundment has some degree of shearing strength, the material would not be expected to "flow" into the river.

Cumulative Effects

No additional cumulative effects are foreseen in the project area related to mineral development. SMC represents the only large employment opportunity in the immediate project area. The East Boulder project is not expected to impact wildlife resources in the Stillwater drainage. Wildlife in the Boulder drainage utilizes and occupies available habitats in that drainage. Likewise, the same habitat occupation use patterns take place in the Stillwater drainage.

When the Beartooth District recreational facilities upgrades indicated in the Stillwater IRA are completed, additional opportunities for recreation will be provided. Recreational use by the general public is expected to level off or grow at a reduced pace as compared to past trends. Therefore, recreation demand will not exceed opportunities.

### 4.4.3 Alternatives 3a Tailing Impoundment No Action and 3c Tailing Impoundment Partial Approval

Direct and Indirect Effects

If these alternatives were selected no structural change to the tailing impoundment would take place. The discussion of alternative 1 provides the same direct and indirect effects analysis as would be expected due to selection of this alternative related only to tailing impoundment considerations.

Under alternative 1 the approval to increase ore production would be denied. Selection of alternative 3c would increase ore production. Therefore, differences due to selection of these alternatives hinge mainly on increased mine employment and traffic volumes. The environmental consequences of increased employee traffic associated with 3b, 3c, or 3d are displayed in the analysis of alternative 2.

Under alternative 3c, SMC would be required to study and submit a plan related to the long-term tailing impoundment needs. Thus, modification of the current tailing facility is not ruled out if alternative 3c is selected. However, any permit change related to future tailing impoundment modification would require the same level of MEPA/NEPA analysis at the time a proposal would be submitted.

Fisheries

If slumping after final reclamation occurs, some of the sediment will likely find its way into the Stillwater River. This may pose a threat to downstream spawning areas and the trout species which use this area.

Cumulative Effects

Same as alternative 2.

### 4.4.4 Alternative 3d Modified Tailing Impoundment

Direct and Indirect Effects

Selection of this alternative would have the same environmental consequences as displayed under alternative 2 with one major difference. The toe dam which currently is heavily used by the sheep for foraging purposes would be totally eliminated. This would be a result of increased impoundment height while maintaining a 2h:1v slope, thus extending the impoundment slope approximately 55 feet toward the Stillwater River. The toe dam would be buried and, therefore, unavailable for sheep utilization. Consequently, 5 additional acres near the base of the present toe dam would be eliminated from sheep use. If this alternative were selected, and sufficient time not provided to either establish alternative foraging areas or allow the sheep to adjust to this new disturbance, the herd may be eliminated within a few years.

Impacts to both bighorn sheep and mule deer related to increased traffic and additional planned ground disturbances are the same as displayed under alternative 2. Expected impacts resulting from a 100-percent vegetated final reclamation scenario are worse than discussed under alternative 1. Slope lengths would increase due to implementation of alternative 3d. Thus, the possibility of mass erosion would increase. If this alternative were selected without new reclamation

specifications, the impoundment slope forage base would be rendered unavailable sometime in the future.

Fisheries

Soil which could be lost from the impoundment face would most likely end up in the Stillwater River. This could pose a threat to the spawning areas downstream of the impoundment.

Cumulative Impacts

Cumulative impacts which would result are the same as those described under alternative 2.

4.4.5 Alternatives 4a, b, and c Water Treatment

Direct and Indirect Effects

Implementation of these alternatives will have no bearing on either the bighorn sheep or mule deer within the project area.

Fisheries

Alternatives 4a, b, and c are evaluated for the purposes of water treatment and compliance with Montana's water non-degradation policy. To date no adverse direct or indirect effects to the Stillwater trout fisheries have been noted due to the addition of nitrates to the ecosystem. Nitrate is generally viewed as a fertilizer. Thus, the possibility exists that addition of nitrate will increase the invertebrate biomass which, in turn, would represent a beneficial effect to the fisheries resource.

Cumulative Effects

No adverse cumulative impacts are expected to occur to either the bighorn sheep or mule deer in the project area other than those which have already been disclosed.

If the addition of nitrates to the aquatic ecosystem results in a better fishery, increase demand may occur for this recreational opportunity. This may lead to overuse of the Stillwater River by fishermen or intense competition for the fishery resource. Increased instances of trespass could occur on private land.

### 4.4.6 Proposed Action with Modifications — Alternative 5

Direct and Indirect Effect

Selection of this alternative would require SMC to enter into a cooperative effort to study vegetation differences which exist between the core winter range and heavily utilized vegetation on the toe dam. This study would explore differences in plant species composition, palatability, and nutrient content. If the results of this study warrant, SMC would cooperate with the regulatory agencies in order to create vegetative conditions on the core winter range which will draw the sheep away for the toe dam area. At a minimum, implementation of SMC's Plan of Operation would require the disturbance of approximately 30 acres of potential sheep and deer habitat. Therefore, a similar area would undergo enhancement. The exact location within the core winter range would be directed by the Coordinated Bighorn Sheep Management Committee which meets at least annually (SMC, August 1991).

Additionally, SMC would continue to implement mitigation prescribed in past analysis documents aimed at preventing the elimination of the sheep herd.

This would result in the minimization of adverse impacts to the bighorn sheep herd. The ultimate goal would be to return the sheep to pre-mining population levels by increasing the overall herd health.

Fisheries

As SMC proceeds toward the stated employment goal of 525 persons, a survey will be conducted to identify any changes in recreational or wildlife use practices resulting from increased employee population levels within Stillwater or Carbon Counties. This effort would help the state and federal agencies identify opportunities for recreation or wildlife uses, or highlight potential problems areas if they exist.

Cumulative Effects

Successful implementation of this alternative may potentially lead to sufficient bighorn sheep herd recovery to warrant the reissuing of bighorn sheep hunting tags within the Stillwater drainage. Increased hunter and guide use within the Stillwater drainage could result. However, this situation is not expected to take place in the foreseeable future.

The East Boulder Project would not have a cumulative effect on the Stillwater bighorn sheep because no Boulder drainage habitats are used by this herd. Sheep within the Boulder drainage are

not expected to be displaced by the East Boulder Project into the Stillwater drainage. Therefore, competition for available habitat will not take place.

## 4.5 Air Quality

### 4.5.1 No Action

Under this alternative, air quality conditions would remain similar to the existing situation. Air pollutant emissions from mining operations are, for the most part, proportional to production rates. There would be a very small increase in particulate emissions associated with wind erosion of disturbed or exposed areas, primarily the tailing impoundment, as the acreage increases.

### 4.5.2 Company's Proposal

The primary pollutant of concern with mining operations is particulate matter. Table 4.5-1 lists the estimated particulate emissions from the project at the proposed production level and the emission controls to be used as shown in SMC's air quality permit application.

The control techniques shown have been determined to represent Best Available Control Technology (BACT) for this project.

As part of the air quality permitting process, SMC must submit verification through computer modeling that the increase in emissions will not cause exceedance of an ambient air quality standard.

SMC prepared a visibility screening analysis to assess the impact to the Absaroka-Beartooth Wilderness Area. The maximum visual impacts inside and outside of the wilderness do not exceed the recommended screening criteria; therefore, there should not be adverse impact on visibility in the area.

Gaseous emissions would result from surface and underground diesel equipment and blasting. The estimated emissions in tons per year are as follows: nitrogen oxides - 118, carbon monoxide - 100, and sulfur dioxide - 11.

No impact to climate would be expected at the emission levels predicted.

### 4.5.3 All Alternatives

The air quality impacts relative to all the alternatives would be very similar to those described in the previous section for the company's proposal. Slight increases in particulate emissions due to

wind erosion could result from increases in the amount of disturbed area relative to tailing impoundment alternatives.

Table 4.5-1 Total Particulate Emissions - Worst-Case Annual Period

STILLWATER MINING CO.
TOTAL PARTICULATE EMISSIONS - WORST CASE ANNUAL PERIOD

| ACTIVITY | UNCONTROLLED EMISSIONS TON/YR | CONTROL MEASURES | CONTROL EFFICIENCY PERCENT | CONTROLLED EMISSIONS TON/YR |
|---|---|---|---|---|
| Topsoil Stockpiles | 0.03 | Revegetation | 75 | 0.01 |
| Disturbed Areas | 2.01 | Revegetation (42 percent) | 30 | 1.41 |
| Coarse Ore Stockpile | 0.01 | None | 0 | 0.01 |
| Mine Ventilation Exhaust | 25.20 | None | 0 | 25.20 |
| Dumping Coarse Ore Into Trucks | 3.65 | Minimize Fall Distance | 0 | 3.65 |
| Load, Dump Coarse Ore Into | 7.30 | Minimize Fall | 0 | 7.30 |
| Haul Roads - Ore To Mill Hopper Grizzly | 2.83 | None | 0 | 2.83 |
| Load, Dump To Coarse Ore Stockpile | 7.30 | Minimize Fall Distance | 0 | 7.30 |
| Haul Roads - Ore To Coarse Ore Stockpile From West | 5.01 | None | 0 | 5.01 |
| Haul Roads - Ore To Coarse Ore From East Side | 67.16 | Chemical Stabilizer/ Watering As Necessary | 85 | 10.07 |
| Dump Waste Rock - 5000-Foot Level (West Side) | 2.28 | Minimize Fall Distance | 0 | 2.28 |
| Load, Dump Waste Rock On Tailing Embankment | 9.12 | Minimize Fall Distance | 0 | 9.12 |
| Haul Roads - Waste Rock To Tailing Embankment | 25.73 | Watering (West Side)<br>Chem. Stab. (East) | 50<br>85 | 6.86 |
| Vehicle Traffice On Unpaved Roads | 36.25 | Chemical Stabilizer/ Watering as Necessary | 85 | 5.44 |
| Diesel Exhaust (Surface) | 1.84 | Operation | 0 | 1.84 |
| Ore Conveyors To SAG Mill | 7.30 | Enclosed In Building | 90 | 0.73 |
| Concentrate Dryer | 1.50 | Wet Scrubber | 0* | 1.50 |
| | 204.52 | | | 90.56 |

* Uncontrolled emissions for concentrate dryer are actually controlled emissions.

## 4.6 Land Uses

### 4.6.1 No Action

Land Uses Outside the National Forest

The effects of the no-action alternative on land uses outside the national forest are expected to be minimal. Since the population of Stillwater County is projected to rise even if the mine does not expand (see Section 4.8.1), the demand for recreation on private, state, or BLM-administered lands

could increase slightly. Long-term trends in land uses, such as the decline in the amount of land devoted to agriculture, are likely to persist, and certain lands outside the national forest will continue to be the focus of exploration activities of the nature described in Section 2.7.

### 4.6.2 Company's Proposal

Land Uses Outside the National Forest

One of the issues which has been raised is that the expansion of the mine will result in a reduction in the value of subdivision property near the mine. A similar issue was identified when SMC submitted a proposal to construct a smelter at the mine site. The issue was addressed in the unpublished preliminary Draft EIS for the smelter (DSL/FS, 1990) by analyzing trends in the value of subdivision lots from before the mine was developed up until 1989 when the DEIS was prepared.

The analysis showed lot prices at the Cathedral Mountain Ranch had appreciated over that period with larger lots showing a greater rate of increase in price than smaller ones. Lot prices in the Whited Subdivision and the Rainbow Ranch had remained fairly constant, although the time on the market had risen. For the Buffalo Ranch subdivision, the price of lots near the river were stable over the period while more remote lots had depreciated somewhat in value.

Based on this evaluation which showed that development of the mine apparently had no negative impact on lot prices, it was concluded that construction of a smelter at the mine site would not affect land values. Since the proposed expansion of the mine also represents a much smaller change to land uses than the original development of the mine, a similar conclusion appears justified.

Under this alternative, impacts to other land uses outside the national forest are expected to be insignificant. The demand for recreation may increase over and above that anticipated under the no-action alternative, but the additional effects of the mine expansion should be slight. Because of the extremely tight rental market, more land currently used for other purposes (e.g., agriculture) may be developed for housing. The impacts of the proposed expansion on wildlife habitat are discussed in Section 4.4.

### 4.6.3 Other Alternatives

Land Uses Outside the National Forest

The impacts would essentially be the same as for the company's proposal.

4.6.4 Recreation

Alternative 1 — (3a, 4a) — No Action

Direct and Indirect Effects

The environmental consequences which would result due to selection of Alternative 1 would represent no change from the existing condition. Currently there are sufficient recreational opportunities which exist to suffice the level of public demand for recreation.

Cumulative Effects

No adverse cumulative effect to recreationist or the recreation resource would be triggered by selection of Alternative 1 since no additional demand for the limited opportunities would occur.

All Remaining Alternatives (2, 3b, 3c, 3d, 4b, 4c, and 5)

Direct and Indirect Effects

The environmental consequences related to all remaining alternatives would be the same. In order to implement any of these alternatives, employment at the mine would be increased to 525. SMC projects that one half of new hires would come from outside the local area. Many of these new employees will bring families to the area as indicated in the socioeconomics analysis.

The direct and indirect effects resulting from selection of one of these alternatives consist of increased human competition for the available recreational opportunities within the Stillwater drainage. As a result of this increased competition, accelerated recreation resource damage may occur to existing facilities. This would be expected to continue until planned capacity upgrades or additional recreational opportunities listed in the Stillwater IRA projects of concern are constructed.

Cumulative Effects

Surveys conducted as the result of mitigation measure 8, prescribed by the 1985 Record of Decision and associated EIS, indicated that SMC employees recreated mainly within the Stillwater drainage. This trend is expected to continue. Therefore, no adverse cumulative effects are projected to occur outside of Stillwater County.

Additionally, other minerals development activities such as Chrome Corporation of America, or Platinum International are not reasonably foreseeable at this time in terms of full scale mine development. Once the East Boulder Project comes on line, persons employed at that facility are not

expected to travel in large numbers to the Stillwater drainage for recreational purposes. Therefore, no adverse cumulative impacts are anticipated at this time.

## 4.7 Aesthetics - Introduction

The CNF's visual resources are managed under the USDA's National Forest Landscape Management System described in USFS Handbooks 434 and 462. This system employs an inventory of the qualitative attributes of each forest acre to produce a VQO that will correspond appropriately to management area prescriptions developed in the Custer National Forest Management Plan (USFS, 1986)

### 4.7.1 No Action

Consequences of selecting the no-action alternative mainly involve the long term goal of Retention for visual quality. All existing disturbances would remain the same along with their attendant reclamation requirements. By not increasing production, the life of the mine would remain the same and the time span for these unreclaimed visual and auditory disturbances could not be reduced.

The most significant visual alteration, the tailing dam, would remain at its current height in this alternative, but would be revegetated entirely with grass. This treatment would blend somewhat with the characteristic valley floor but would emphasize the strong horizontal line made by the top of the dam.

### 4.7.2 Company's Proposal

Consequences of selecting this alternative result from the proposal to double daily production rates, necessarily raising the current dam height 14 feet. For final reclamation, rock armor for erosion control on the tailing dam, at 1.6h:1v is also proposed.

Impacts relating to the height of the dam in all alternatives vary only in degree in the short term but have greater effects in terms of meeting objectives at the cessation of mining operations. In this alternative, visual impacts are greatest due to the proposed increase in observable surface area of the dam and in the uniformity of the erosion control method. Variety in the landscape is the most significant aspect of scenic quality. Regardless of dam height, the two alterations that will have the most effect on whether the VQO of Retention will be attained are the horizontal top line of the dam and the final treatment for the slope. These two, particularly the top of the dam, can be perceived by travelers along the valley highway from middleground and background distances up to five or six miles. In the foreground, the impact is more a problem of texture. The uniform slope is out of place in this environment of natural variety.

4.7.3 Tailing Impoundment Alternatives

3a. Same as no action -- see No Action Alternative above

3b. Same as SMC Proposal -- see SMC Alternative above

3c. Visual impacts would be the same as the no-action alternative unless reevaluation raised dam height.

3d. Visual impacts would be greater than but of the same type as the no-action alternaitve because the grass revegetation would dominate the view of the tailing impoundment. It would also emphasize the increased height.

4.7.4 Water Treatment Alternatives

These alternatives have no effect on visual quality.

4.7.5 Mitigated Company's Proposal

Implementation of this alternative would reduce the amount of visual disturbances during mining operations, increase variety in form and texture, as well as considerably shortening reclamation time necessary to achieve the Retention visual quality. This alternative would make reductions in existing adverse visual impacts as well as those resulting from proposed actions. Through the incorporation of the mitigation measures that are part of this alternative, natural visual variety would be increased on the embankment, the line formed by the top of the dam would be broken, and screening would be provided in administrative areas that could help conceal buildings and cars in the daytime and veil operational lighting from the rest of the valley at night.

4.8 Socioeconomics/Traffic

4.8.1 No Action

4.8.1.1 Socioeconomics

Under the no-action alternative, expansion of the mine would not occur and production levels would remain at about 1,000 tpd. The employment and income generated by the expansion would be foregone, and the additional demands on housing and community services would be avoided. The local economy would continue to grow, but at a slower rate. Following are population and employment projections under this alternative.

Population

Projections by NPA Data Services (1991) indicate that the population of Stillwater County is expected to increase to 7,010 in 1995 and 7,350 in the year 2000. (The population effects of the mine expansion are not taken into account in the projections.) From a July 1, 1990 estimated population of 6,550, these projections represent a growth rate of 1.4 percent per year over the 1990-1995 period and 0.9 percent annually from 1995 to the year 2000. The Stillwater County population is, therefore, forecast to expand at a slower rate than was experienced in the 1980's. The population of Montana is expected to grow by only 0.7 percent per year between 1990 and 1995 and 0.6 percent from 1995 to 2000.

Employment

Published employment projections consistent with the updated population estimates are not readily available. Therefore, total employment was projected simply by using the 1990 employment-to-population ratio for Stillwater County of 49 percent. Applying this percentage to the population forecasts discussed above yields employment projections for 1995 and 2000 of 3,456 and 3,623, respectively.

### 4.8.2 Company's Proposal

#### 4.8.2.1 Socioeconomics

The effects of the company's proposal on population, employment, and income were assessed using IMPLAN, a computerized input-output model. Detailed information on IMPLAN is available upon request. It should be noted that the economic and social impacts discussed below are applicable to a production level of 2,000 tpd. Since the expansion is likely to take place incrementally, the impacts will not be realized at once, but, instead, will be spread out over several years. Also, no attempt has been made to estimate the economic or social impacts caused by construction-related activity.

Employment

The effects of the proposed expansion on employment in Stillwater County can be categorized into direct, indirect, and induced impacts. Direct impacts are the effects on the initial sector experiencing a change in final demand, which, in this case, is the mining industry. Indirect economic impacts refer to the impacts on industries which provide inputs to the mining sector (e.g., electric power), and induced impacts are those which result from employees and business owners spending their income within the area. Depending upon the type of impact and, hence, the industries that are

affected, employment generated by the project can be a mixture of seasonal, year-round, full-time, and part-time positions.

According to the plan of operations, employment at the mine would rise to 525 once the targeted production rate of 2,000 tpd is reached. Employment would then be 161 above the post-layoff March 31, 1991 figure of 364, but only 42 higher than the December 31, 1990 total of 483 employees. The plan of operations uses 460, the maximum employment projected in the 1988 amendment to the Hard Rock Mining Impact Plan, as the base employment figure from which changes are measured. By contrast, this analysis will use the most current employment level, 364, as the benchmark. The direct employment impact of the project is, therefore, 161 jobs. These would be full-time, year-round positions.

It is estimated that approximately 39 jobs will be created in several different sectors (e.g., motor freight, wholesale trade, maintenance and repair facilities) due to the indirect effects of the proposed expansion. This figure was derived by making adjustments to the output from the IMPLAN model to better reflect local economic conditions. For example, according to the model results, the estimated indirect employment impact of the expansion may have been quite large for a particular sector. If this sector already provided goods or services to the mine, this presumably would have been reflected in actual employment trends in Stillwater County over the past several years.

For many such sectors, employment has been relatively stable since before the mine began producing or has even declined. Thus, the initial estimates generated by the IMPLAN model of the indirect impacts of the proposed mine expansion were clearly too high, either because the production function used in the model was not specific to this operation and some inputs are not actually used by the mine or because the mine does need these inputs, but they are supplied from outside the county. Adjustments to the model to reduce the indirect employment impacts for several sectors were, therefore, made, but the indirect effects may still be somewhat overstated for the reasons discussed above. It should also be noted that employment impact for many industries amounted to less than a full-time position, so the result may be an increase in the hours worked by current employees, rather than the hiring of additional persons.

The induced impacts of the project caused by spending by employees and business owners is anticipated to generate another 32 jobs in Stillwater County, with most of these occurring in the retail trade and services sectors. Adjustments similar to those made for the indirect employment estimates were also required for the projections of the induced impacts. Aggregating the direct, indirect, and induced impacts of the proposal then results in a total employment impact of 232 jobs (Figure 4.8-1).

Income

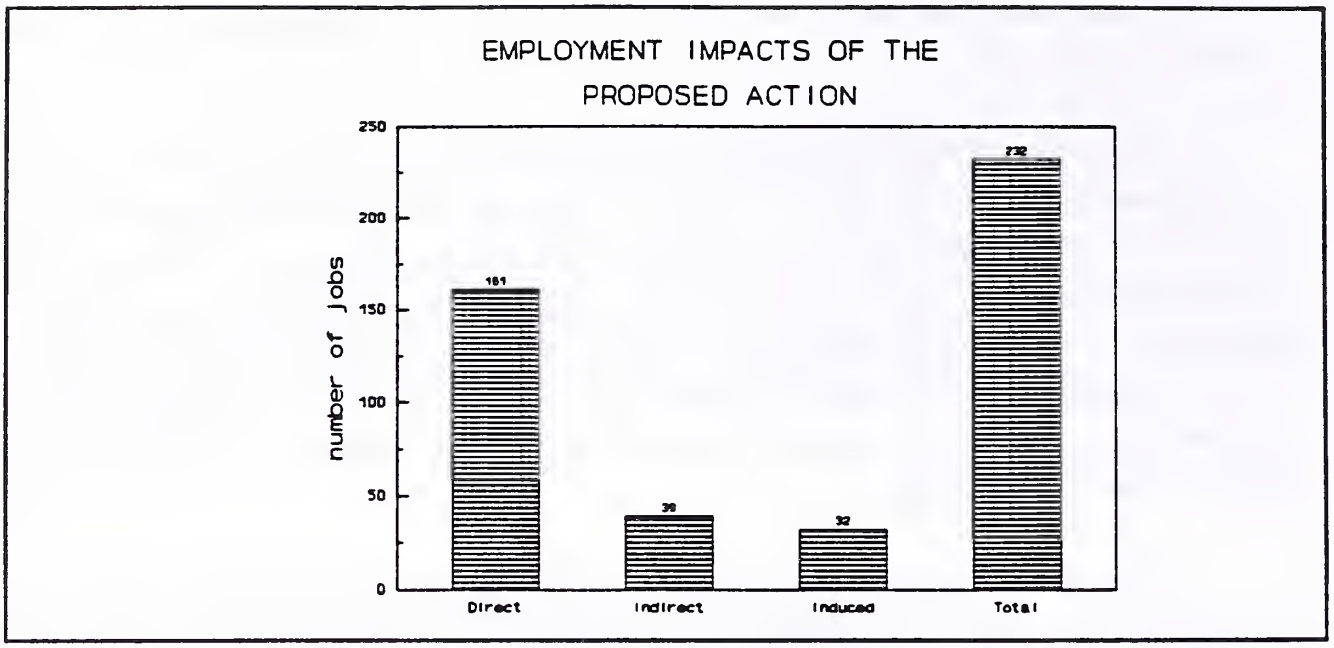

Figure 4.8-1 Employment Impacts of the Proposed Action

Expressed in constant 1990 dollars, approximately $9.1 million in income would be generated in Stillwater County from the expansion of the mine. The direct impact on the mining sector accounts for about 71 percent of the total, or $6.5 million, with the indirect and induced impacts making up the remainder. This income estimate includes not only employee compensation, but also property income such as profits, rents, royalties, and interest. Property income is reported by place of production rather than by place of residence of the owners, so the income impact on Stillwater County may be overstated to the extent that the property owners live elsewhere.

Population

According to the plan of operations, the company anticipates that, of the 65 employees to be added to their base employment level of 460, about 30 will be hired from the local labor force and the remaining 35 will migrate into Stillwater County from other areas. Although, as discussed above, the number of employees currently working at the mine is less than 460, a review of the Quarterly Impact Monitoring Reports over the period when employment rose to 483 and then declined to 364 indicates that 35 is a reasonable estimate of the number of inmigrating workers required to achieve the targeted employment level of 525.

The plan of operations also indicates that the 35 in-migrating workers and their families will increase the Stillwater County population by 107. Under similar assumptions about the local hire percentages, the population change estimates from the IMPLAN model were somewhat less than the company's, because the IMPLAN model used a lower population-to-employment ratio. Since SMC's figures were based upon actual experience at their mine, their estimates are regarded as more reliable.

According to the plan of operations, in-migrating employees in secondary industries and their families are expected to add another 22 persons to the Stillwater County population. This appears to be based, however, on an estimate of the number of secondary jobs that is below that generated by the IMPLAN model. Using the IMPLAN estimates for the indirect and induced employment impacts of the expansion, making the assumption that 20 percent of these jobs will be filled by persons from outside the county, and then applying an average household size of 3.0 persons results in an indirect and induced impact-related population expansion of 43 and, therefore, a total population increase of 150 persons. Adding 150 to the estimates for the no-action alternative yields population projections of 7,160 for 1995 and 7,500 for the year 2000.

Housing

The addition of over 50 new households to Stillwater County will place further pressure on an already tight housing market. Rentals will be even more difficult to find than they already are, as additions to the rental housing stock will continue to lag behind demand. SMC's plan to phase out the mobile home park at the Stratton Ranch will eliminate that source of temporary housing. An adequate supply of building sites is available at the Circle T Ranch and at other locations in the county for those inmigrating employees seeking to construct a home, but it normally takes three months or more to build a house. During the construction period, those employees would also be competing for the extremely limited supply of rental housing.

Rents will continue to escalate at a rapid rate, and inmigrating employees may have to tolerate a longer commute in order to find suitable housing. As discussed in the Affected Environment section, some current workers already commute from as far away from the mine as Columbus and Red Lodge.

Community Services and Facilities

The effects of the mine expansion on community services and facilities will primarily depend upon the geographic distribution of the in-migrating workers and their families. Any problems associated with the population growth would, of course, be more severe if the in-migrants tended to move to one particular location, but this is viewed as unlikely given the limited availability of housing throughout the area. A more likely scenario would be for the in-migrants to settle in a pattern similar to that of current SMC employees who moved to Stillwater County to work at the mine. This would mean that the largest share of the in-migrating population would live in or near Absarokee with fewer moving to, for example, Columbus or Red Lodge.

The increase in population caused by the expansion of the mine would strain the ability of local jurisdictions to provide some services, but not others. At certain grade levels, the Columbus and Absarokee schools could not accept additional students without exceeding accreditation standards

for class size or running out of classrooms. The Fishtail and Nye elementary schools, on the other hand, could accommodate the number of students which would likely move into their respective districts.

As discussed above, the sewer system in Columbus is currently at capacity, so any population growth in Columbus will necessitate an expansion of the system, probably through the addition of aerators. The distribution lines in Columbus' water system also need to be upgraded. Absarokee is experiencing similar difficulties with aging distribution lines in its private water system and one of the storage tanks is leaking, problems which would likely be exacerbated by increases in population. With a private water system, Absarokee is not eligible to use certain sources of funding which might otherwise be available if its water system were public.

Additional traffic caused by greater employment at the mine and population growth will increase the need for road maintenance. According to the Entercom survey, the poor condition of the roads was one of the most often-cited disadvantages to living in Stillwater County. Although the survey was conducted 10 years ago and road upgrades are occurring (e.g., FAS 419), road maintenance still seems to be an important issue with area residents.

The population increase should not adversely affect the capability to provide other services, such as fire protection, law enforcement, emergency services or medical care.

Property Tax Base

The impacts of the mine expansion on community services and facilities could be mitigated through amendments to the Hard Rock Mining Impact Plan, even if this alternative, the company's proposal, were selected. Whether the Impact Plan is amended depends upon the severity and geographic distribution of the effects, and any mitigation measures that are applied will be similar to those discussed in Section 3.8.6.

Cumulative Impacts

The nature, scale, and timing of related development activities on the CNF (see Section 2.7) suggest the cumulative impacts on employment, population, income, housing, and community services and facilities will not be appreciably different than the effects of the mine expansion alone. By virtue of their location, projects on the Gallatin National Forest (Section 2.6.2) will, in all likelihood, have negligible socioeconomic impacts on Stillwater County. Some Stillwater County residents could, however, commute to the East Boulder Project.

4.8.3 Other Alternatives

Impacts for all alternatives except for the no-action alternatives (1, 3a and 4a) would be the same as the company's proposal — alternative 2.

4.8.4 Traffic

Alternative 1 — No Action

During the scoping effort for this project, concerns were raised by both SMC employees and the general public related to potential increases in mine related traffic resulting from implementation of the company's proposal. Generally, employees indicated that the 3.0 passengers/vehicle mitigation measure was an infringement upon their civil rights to travel state and county roads. The general public expressed concerns about a number of items including traffic-related impacts such as noise and dust generation, to their quality of life. Please refer to Chapter 1 for additional concerns raised. The majority of the public voicing these concerns lived in the vicinity of Fishtail, MT.

The DSL and USFS have consulted their respective legal counsels regarding their authority to impose the traffic mitigation requirement. The Forest Service does not have the regulatory authority to enforce the traffic mitigation requirement because its authority does not extend beyond National Forest System lands. However, the DSL has the authority to mitigate mine-related impacts outside the mine permit area. Therefore, DSL may legally administer the mitigation measure in question.

Direct and Indirect Effects

If the no-action alternative were selected, traffic impacts would be within the scope of analysis conducted for the East Side EA/PER. The projected level of employment during that analysis was 460. SMC exceeded the 460 level during February of 1991. The employment level at that time was approximately 480. That employment level and associated traffic impacts are currently covered by the Hardrock Mining Economic Impact Plan.

Latest employment figures supplied by SMC indicate that 364 persons are working at the mine. SMC is presently in compliance with the 3.0 passenger/vehicle mitigation measure which results in approximately 121 mine related vehicles traveling the access corridors to and from the mine on a daily basis. Therefore, the selection of the no-action alternative would not result in additional direct or indirect effects.

Cumulative Effects

Projects which may cumulatively effect traffic volumes on roads leading to and from the SMC include campground, trailhead, and recreational hiking trails upgrades. The resulting increased recreational traffic would further add to degradation of lifestyles for those residents of Stillwater County which live along the access routes. Similarly, additional personal safety or traffic law violations would be expected to increase to some degree. Negative impacts to the Stillwater bighorn sheep herd would most likely not take place during the winter months due to the continuation of the area restriction.

Alternative 2 - Company's Proposal

Direct and Indirect Effects

SMC has requested relief from the traffic mitigation measure aimed at achieving a 3.0 passenger occupancy rate per vehicle traveling to the mine. If this request were granted, it would result in an increase of mine related vehicles utilizing FAS 419, FAS 420, and FAP 78. Currently SMC employs approximately 364 persons at the mine, utilizing approximately 121 vehicles each day commuting to work assuming the 3.0 occupancy rate is met for that day. It is reasonable to expect that the average occupancy rate per vehicle would fall to between 2.0 to 2.5 passengers per vehicle if the mitigation measures were not enforced. This situation would be further complicated when the projected employment level of 525 is achieved sometime in the future. A comparison of these employment levels and the resultant traffic volumes are displayed in Table 4.8-1. The worst case scenario in terms of mine-related vehicles using access corridors would be an increase of over 200 percent (from 121 vehicles/day to 262 vehicles/day) when the full employment level of 525 persons is realized, and if simultaneously the vehicle occupancy rate falls to 2.0.

Table 4.8-1. Projected Mine-Related Vehicle Traffic per Day

| Number of Employees | Vehicle Occupancy Rate 3.0 | 2.5 | 2.0 |
|---|---|---|---|
| 365 | 121 | 146 | 182 |
| 525 | 175 | 210 | 262 |

Cumulative Impacts

Projects which may cumulatively effect traffic volumes on roads leading to and from the SMC include planned campground, trailhead, and recreational hiking trails upgrades. The resulting increase in recreational traffic would further add to degradation of lifestyles for residences of

Stillwater County which live along the access routes. Similarly, additional personal safety or traffic law violations would be expected to increase to some degree. Additional impacts to the Stillwater bighorn sheep herd are not expected to take place as a result of increased recreational vehicle traffic. The area restriction will be continued from December 1 to April 15 when the sheep occupy the winter range. Therefore, the potential for sheep and human interaction will be eliminated.

Tailing Impoundment and Water Treatment Alternatives - 3c, 3d, 4b and 4c

All the remaining alternatives require the same level of employment in order to be implemented. These alternatives are concerned with various tailing impoundment and water treatment scenarios. The employment level is projected to be 525. Therefore, the direct, indirect, and cumulative impacts would be the same as indicated in the company's proposal.

Proposed Action with Modifications

In order to minimize the environmental consequences of the company's proposal, the following mitigation would be implemented.

The request for relief from the 3.0 passenger/vehicle mitigation will not be granted. However, the requirement for monthly data collection and mitigation adherence reporting will be reduced to twice a year. These data will be supplied to the Montana DSL and the FS for the months of March and September. The average of these two months must meet or exceed the 3.0 goal. Additionally, mine employees living with 10 miles of the mine will not be figured into the vehicle occupancy goal.

Approval for replacement of the west side parking lot due to building expansion will be granted, but no total acreage expansion will be allowed. Construction of a parking facility on the east side of the Stillwater River will be approved as outlined in the company's proposal.

Analysis Leading to Mitigation

Direct and Indirect Effects

If this alternative were selected, the environmental consequences to mine employees would remain unchanged as compared to the current condition. Employees living outside of the 10 mile zone would be required to car or van pool while accessing or leaving the mine area. These persons would continue to have their use of state and county roads restricted during the time of access to or departure from the work place. Indirect consequences from selection of this alternative would include reduced road maintenance cost to Stillwater County, decreased potential for vehicle accidents due to reduced traffic volumes, and possible reduction of wildlife/vehicle collisions (roadkills).

Likewise, the environmental consequences to the general public would remain relatively unchanged from the current or recently past conditions. SMC intends to increase employment to 525 persons via this amendment. Prior to recent layoffs at the mine, SMC had employed approximately 480 persons (February, 1991). During this time the 3.0 mitigation measure was being met. This resulted in a daily traffic volume of approximately 160 vehicles traveling to and from the mine daily. When SMC achieves full employment, there will be an additional 45 persons employed above the historic high employment figure. The persons who occupy these vehicles will be required to comply with the passenger/vehicle mitigation measure. This will result in an increase of 15 vehicles traveling to and from the mine. This represents an increase of 9.4 percent in SMC mine related traffic as compared to the historic high.

Currently SMC employees 364 persons at the Nye facility. The company is currently in compliance with the traffic reduction mitigation measure which results in approximately 121 vehicles per day traveling to and from the mine site. Once the anticipated employment level of 525 is reached, an additional 161 persons will be hired above the current employment level of 364. This should result in an increase of 53 mine related vehicles traveling to and from the mine daily. This represents an increase of 44.4 percent over current mine related traffic volumes. Although this represents a significant increase in mine related traffic, it must be remembered that this increased volume will be distributed over three different access corridors. Additionally, SMC related traffic does not constitute the only traffic on these access corridors. Use by the general public and farm or ranch operations also contribute to the final volume of traffic.

The expansion of the 10-mile mitigation exemption zone from the previously permitted 2-mile zone is not expected to impact members of the public who expressed traffic related concerns. Most traffic respondents lived in the vicinity of Fishtail, MT which lies approximately 23 miles to the north-east of the project area. Requiring mine employees who live within the 10-mile zone to comply with the 3.0 goal would cause unwarranted scheduling and monetary burden on these persons. These people would be required to drive out of their way in order to participate in the car or van pooling effort.

Additional impacts to the Stillwater Valley bighorn sheep herd are not expected to take place due to increased traffic. The impact threshold has already been triggered in these sheep. Therefore, the sheep are not expected to perceive the addition of more mine related traffic.

The west side parking facility currently provides adequate space for mine employees to park if the current mitigation measure is met. Thus, additional west side parking is not necessary. However, that area taken by facility expansion may be replaced. No parking currently exists on the east side of the Stillwater River. This area will experience increase support facility development, and some of the administrative staff may be housed in newly constructed facilities. Therefore, adequate parking facilities must be provided for these personnel.

Cumulative Effects

Projects which may cumulatively effect traffic volumes on roads leading to and from the SMC include planned campground, trailhead, and recreational hiking trails upgrades. The resulting increase in recreational traffic would further add to degradation of lifestyles for residences of Stillwater County which live along the access routes. Similarly, additional personal safety or traffic law violations would be expected to increase to some degree. Additional impacts to the Stillwater bighorn sheep herd are not expected to take place as a result of increased recreation vehicle traffic. The area restriction will be continued from December 1 to April 15 when the sheep occupy the winter range. Therefore, the potential for sheep and human interaction will be eliminated.

## 4.9 Commitment of Resources

### 4.9.1 Irreversible and Irretrievable Impacts

Increased ore production allowed under Alternatives 2, 3b, 3c, 3d, and 5 would be a permanent irreversible commitment of almost 4 million more tons of ore.

Tailing impoundment 3b would result in 47 acres of irreversibly lost wildlife habitat.

Increased power demands of advanced water treatments (Alternative 4c) would result in irreversible loss of power resources.

Increased employment might result in unquantified irreversible impacts associated with housing development activity in Stillwater County.

Erosion of soils during periods of non-vegetation would result in an irreversible loss. Productivity would be decreased temporarily.

### 4.9.2 Other Impacts Cannot be Totally Mitigated

Some visual impacts would occur if either Tailing Impoundment 3b or 3d is chosen due to the increased height.

Stockpiled soils lose some productivity because of the destruction of their structures and microbiological activity.

The 30-acre increase in disturbance area would withdraw this amount of habitat for the life of this proposal. On-going reclamation and habitat improvement programs help reduce this impact.

Depending upon the options selected (Water Alternative 4b, or 4c), a small, to a varying degree, irretrievable loss of water quality would occur which would extend throughout mine operation and for a few years after closure. The amount would be limited by the BHES decision.

Increased production would result in air quality losses until reclamation. The amount would be limited to levels set in the Air Quality Permit.

# CHAPTER 5 - COMPARISON OF ALTERNATIVES

## 5.0 Summary and Comparison of Alternatives

The purpose of this chapter is to summarize and compare the alternatives in relation to their major impacts. Table 5.0-1 shows graphically how impacts to a resource might change between alternatives, or reading downward, what the major impacts for that alternative would be. The reader is encouraged to refer back to appropriate sections of the document for complete analysis.

This chapter is organized by alternative so that the major impacts resulting from selecting that alternative are listed in one place. The no-action alternative 1 is usually considered the standard against which all other alternatives are compared. It is presently permitted and, thus, tells what is happening or what will happen if no action is taken.

## 5.1 Alternative 1 — No-Action

No-action would continue operations as presently approved, and most impacts would remain near current levels. Production would remain at 1,000 tpd. The tailing impoundment would not be altered. Capacity would allow a 22-year mine life until the year 2013. Reclamation of the embankment slope would be marginal. The question of the impoundment surface gradient would have to be revisited before final reclamation to ensure that sufficient material is placed on the surface to allow for consolidation and settling.

Because no new or enlarged source of pollution would be developed under this alternative, the MPDES surface water permit would be renewed based on existing effluent limitations. To meet these limitations SMC would have to provide additional treatment to remove total suspended solids and that would concurrently reduce metal concentrations. Limited degradation for ammonia, nitrate and copper would occur at low flow, but no surface water quality standard would be exceeded.

SMC uses both land application and infiltration through percolation ponds because they are effective treatments for removal of total suspended solids (both methods) and the nitrogen species (land application). Groundwater concentrations of ammonia and nitrate and dissolved chromium would increase slightly but would not exceed standards outside the SMC property boundary.

The present reclamation plan would probably have marginal success, but it could be improved by increasing the amounts of replacement soil. Three factors have led to limited soil salvage: 1) many of SMC's facilities were built purposely on old mining and town disturbances to minimize environmental impacts; 2) amounts of salvageable soil were limited by the presence of large boulders and a high water table; and 3) the value of subsoils with high rock content has been proven. The limited amount of soil has led SMC to test the ability of TBM and other waste materials to grow

Table 5.0-1 Summary of Alternatives

| Issue | No-Action - Alternatives 1,3a and 4a | Company's Proposal - Alternatives 2, 3b, 4b | Partial Approval Alternative 3c | Modified Impoundment Alternative 3d | Advanced Treatment Alternative 4c | Company Proposal with Modifications Alternative 5 |
|---|---|---|---|---|---|---|
| Tailing Impoundment Construction<br><br>Section 4.1 | Above factors of safety for mass failure;<br>Impoundment size the same;<br>22 year capacity @ 1000 tpd;<br>No waste rock surplus; | Approaching factors of safety for mass failure;<br>Size increased 4 acres<br>17 year capacity @ 2000 tpd;<br>330,000yd$^3$ waste rock surplus; | Above factors of safety for mass failure;<br>Size remains the same;<br>12 year capacity @ 2000 tpd;<br>No waste rock surplus | 9 acres larger than present;<br>Above factors of safety for mass failure;<br>Size increased 9 acres;<br>17 year capacity @ 2000 tpd;<br>250,000yd$^3$ waste rock deficit;<br>must relocate FS 419; | Disposal of additional sludges and/or brines. | No impacts |
| Water Resources<br><br>Section 4.2 | Nondegradation does not apply<br>MPDES permit renewed based on existing limitations;<br>Limited degradation of surface water for ammonia, nitrate and copper would occur at low flows; no surface water quality standard would be exceeded;<br>Groundwater concentrations of ammonia, nitrate and dissolved chromium would increase slightly but would not exceed standards at permit boundary; | Nondegradation applies;<br>Petition to change ambient water quality for total dissolved solids, ammonia, nitrates and metals in both surface and groundwater requires decision by the BHES;<br>Numeric water quality standards would not be exceeded;<br>Human health and aquatic organisms would not be negatively impacted if petition were granted. | Nondegradation applies;<br>Petition to change ambient water quality for total dissolved solids, ammonia, nitrates and metals in both surface and groundwater requires decision by the BHES;<br>Numeric water quality standards would not be exceeded;<br>Human health and aquatic ogranaisms would not be negatively impacted if petition were granted. | Nondegradation applies;<br>Petition to change ambient water quality for total dissolved solids, ammonia, nitrates and metals in both surface and groundwater requires decision by the BHES;<br>Numeric water quality standards would not be exceeded;<br>Human health and aquatic organisms would not be negatively impacted if petition were granted. | Existing water quality conditions would be maintained;<br>May require use of additional chemical reagents;<br>Increased water withdrawals from the Stillwater River. | Nondegradation applies;<br>Petition to change ambient water quality for total dissolved solids, ammonia, nitrates and metals in both surface and groundwater requires decision by the BHES;<br>Numeric water quality standards would not be exceeded;<br>Human health and aquatic organisms would not be negatively impacted if petition were granted.<br>Advanced treatment required only if ambient concentrations are exceeded. |
| Soils and Reclamation, including Tailing Impoundment<br><br>Section 4.3 | No increased disturbances;<br>Marginal reclamation because of limited replacement soil;<br>Long tailing embankment slopes increase erosion potential;<br>Irrigating with nitrate increases plant growth; | About 35 acres of new disturbance;<br>Marginal reclamation because of limited replacement soils;<br>Rock armored embankment stops soil erosion but eliminates vegetative productivity on 42 acres;<br>Irrigating with nitrate increases plant growth; | About 20 new acres of disturbance;<br>Marginal reclamation because of limited replacement soils;<br>Long embankment slopes increase soil erosion potential;<br>Irrigating with nitrate increases plant growth; | About 30 new acres of disturbance;<br>Marginal reclamation because of limited replacement soils;<br>Lengthened embankment slope increases erosion potential;<br>Irrigating with nitrate increases plant growth; | No impacts | Changed soil salvage standards increases replacement volumes;<br>Review leads to identification of soil borrow areas to increase soil depths and reclamation potential;<br>Mosaic pattern on embankment reduces erosion substantially; |

| Issue | No-Action - Alternatives 1,3a and 4a | Company's Proposal - Alternatives 2, 3b, 4b | Partial Approval Alternative 3c | Modified Impoundment Alternative 3d | Advanced Treatment Alternative 4c | Company Proposal with Modifications Alternative 5 |
|---|---|---|---|---|---|---|
| Wildlife<br><br>Section 4.4 | Bighorn sheep herd continues to be threatened;<br>Major winter forage on toe dike remains;<br>Future reclaimed embankment might be foraged by bighorns; | Bighorn sheep herd continues to be threatened;<br>Rock armor eliminates forage on toe dike and potential on reclaimed embankment; | Bighorn sheep herd continues to be threatened;<br>Reclaimed embankment might be foraged by bighorns;<br>Toe dike forage remains; | Bighorn sheep herd continues to be threatened;<br>Reclaimed embankment might be foraged by bighorns but toe dike lost;<br>Lengthened embankment might produce less forage than present plan because of erosion; | Added disturbance area decreases habitat desirability; | Mosaic reclamation enhances desirability by increasing diversity and productivity; |
| Air Quality<br><br>Section 4.5 | No impacts | Some increase in emissions due to increased production | Some increase in emissions due to increased production | Some increase in emissions due to increased production | Some increase in emissions due to increased production | Some increase in emissions due to increased production |
| Land Use<br><br>Section 4.6 | No impacts | Recreational use would increase some | Recreational use would increase some | Recreational use would increase some | Recreational use would increase some | Recreational use would increase some |
| Aesthetics<br><br>Section 4.7 | Visually uniform vegetation;<br>Dam height unchanged;<br>Moderate time to achieve retention of visual quality;<br>No visual screening; | Visually uniform rock armor;<br>Dam height raised 14 ft;<br>Longer time after closing to achieve retention of visual quality, but shorter impoundment life;<br>Visual screening berm on east side; | Visually uniform vegetation;<br>Dam height unchanged;<br>Moderate time after closing to achieve retention of visual quality but shortest impoundment life;<br>No waste rock available for east side visual screening berm; | Visually uniform vegetation;<br>Dam height raised 15ft;<br>Moderate time after closing to achieve retention of visual quality, but shorter impoundment life;<br>No waste rock available for visual screening berm; | Could have visual impact during operations; | Most varied visually;<br>Dam height could be raised 15 ft;<br>Shortest time to achieve retention of visual quality due to mitigation and shorter impoundment life;<br>Probably no waste rock available for visual screening berm; |
| Socioeconomics/Traffic<br><br>Section 4.8 | Population will grow 800 by year 2000;<br>Housing will remain tight;<br>Some school, sewer and water services will exceed capacity in Columbus and Absarokee;<br>Traffic problems will reduce slightly due to road upgrades; | Total employment impact of 232 jobs;<br>Coiunty population increase of 150 over projections;<br>Impacts on housing and community services and facilities more severe;<br>Traffic doubled to about 262 cars per day; | Total employment impact of 232 jobs;<br>Coiunty population increase of 150 over projections;<br>Impacts on housing and community services and facilities more severe;<br>Traffic doubled to about 262 cars per day; | Total employment impact of 232 jobs;<br>Coiunty population increase of 150 over projections;<br>Impacts on housing and community services and facilities more severe;<br>Traffic doubled to about 262 cars per day; | | Total employment impact of 232 jobs;<br>Coiunty population increase of 150 over projections;<br>Impacts on housing and community services and facilities more severe;<br>Traffic increased by about 25 cars per day; |

vegetation. Since original permitting in 1985, reclamation theory has also evolved so soil salvage standards have changed. Now it is known that long slopes with 100 percent vegetation may not be the most desirable and, in fact, could have detrimental effects such as excessive soil erosion. SMC has voluntarily instituted new soil salvage procedures but these have not been formally adopted in the reclamation plan.

Wildlife impacts would remain approximately the same. As reclamation continues, the mine site's winter range, particularly the toe dike, seems to attract more deer and bighorn sheep. The numbers of deer are expected to continue to increase while the viability of the bighorn herd, even with present mitigation, continues to be in doubt.

Air Quality, Land Use, and Aesthetic impacts are expected to remain at present levels.

Socio-economic trends indicate that Stillwater County population will grow at rate of over 1 percent per year until the year 2000 if mine activity were to remain constant. This would be about 800 new persons for a total population of about 7350. Total employment would increase by approximately 400 over the 1990 annual average of 3,229. Housing would remain tight with rentals particularly hard to find. Some school grades in Columbus and Absarokee are presently near accreditation standards and the projected population growth could push them beyond those standards. Also the Columbus sewer system is at capacity and should be expanded before service is expanded. The Absarokee water system needs replacement of aging water lines before increasing service.

Certain road improvements are currently taking place but the condition of area roads continues to be problematical.

## 5.2 Alternative 2 — Company's Proposal

The company's proposal is driven by its request to increase ore production to 2000 tpd and increase total production by 4 million tons to 13.2 million tons. This would lower unit costs and make the operation more economically viable. To accommodate increased total production, tailing capacity must be increased. The company's proposal would: 1) enlarge the impoundment from 66 to 70 acres total; 2) raise the height 15 feet from 141 to 155 feet; and 3) steepen the outside embankment slope from 2h:1v to 1.6h:1v. SMC also proposes to rock armor the steepened embankment slope. The four major results of this proposal are: 1) the increased capacity of the facility would allow 2000 tpd production to proceed for 17 years until 2008, which is 5 years shorter than alternative 1; 2) factors of safety concerning mass failure of the dam would be lessened; 3) 42 acres of vegetation on the embankment including the toe dike, would be lost; 4) 330,000 cubic yards of excess waste rock would be generated, which SMC proposes to use as a visual berm to screen east side facilities; and 5) about 30 more acres would be disturbed. These changes could be significant.

Under the Water Quality Act, if production were increased to 2000 tpd, the increased amount of water would be considered a new and enlarged source of discharge, and would be covered by nondegradation rules. As a result, SMC petitioned the BHES for an amendment to ambient standards for surface water for nitrate and some metals. Direct discharge of water to the Stillwater River would increase the concentration of nitrate, chromium, iron, manganese, nickel and zinc if the river were at low flow; under average flow only nitrate and manganese concentrations would increase. SMC proposes to continue using the same methods to treat water, that is, clarification and either land application or percolation. The tailing impoundment and the mill are zero-discharge facilities. Surface water quality standards would not be exceeded. Human health and aquatic organisms would not be adversely impacted. Some of these impacts are not considered significant.

As a result of discharge to the SRV percolation ponds, nitrate and total dissolved solids would increase slightly under either low or average flow, but metal concentrations would not be affected.

Soil salvage and reclamation would remain the same except for the impoundment embankment. Not redistributing soil on the embankment would obviously eliminate soil erosion there. All other aspects of reclamation are the same as alternative 1.

The bighorn sheep would be adversely impacted by the elimination of vegetation on the embankment and toe dike because they presently forage the mine's reclaimed areas heavily in winter. Any loss of winter habitat is expected to have major impacts on the herd's already precarious existence. The potential loss of the herd has been previously discussed in detail in the original environmental impact statement (USFS/DSL, 1985). Habitat improvement efforts have so far been unsuccessful in weaning the sheep from the permit area. Present mitigation would continue, including the yearly review of its effectiveness. These potential effects are unchanged from those identified as significant in 1985.

Other wildlife including deer and mountain lions do not seem to be dependent upon the mine's reclamation.

Increased production would have some air quality impacts. However, ambient air quality would still remain well below applicable standards and, thus, impacts are not significant.

Some land use changes could occur due to increased employment and projected population growth. Recreational use would increase to some extent. Neither change is considered significant.

The visual impacts of increasing the height of the tailing impoundment and replacing the vegetation on the embankment with rock armor would be that it would be more difficult to camouflage the long linear lines of the impoundment and it would take a longer time to achieve the goal of retention of visual quality. These impacts are comparable to those defined in the 1985 EIS.

Socio-economic impacts of the company's proposal would be proportional to those expected under alternative 1. By the year 2000, Stillwater County's population would total 7500, which is 150 more residents than projected under Alternative 1. Most of the increase would center around Absarokee. The housing market would remain tight with probable increases in rents. Some school facilities in Columbus and Absarokee would exceed accreditation standards with projected population growth so that growth attributable to the mine would increase the severity of the problem. Similar problems would also occur concerning sewer service in Columbus and water service in Absarokee since both of these systems presently need upgrading. No financial predictions were made concerning projected growth of the county, but the mine expansion would contribute about $9 million dollars in wages to the local economy by the year 2000. Effects due to mining activities have been analyzed and thus are not considered significant.

Traffic to the mine could double if the car-pooling mitigation is dropped as SMC has requested. Before car-pooling was instituted occupancy hovered slightly above 2 passengers per vehicle. Using this occupancy and projected employment of 525, traffic would increase from 121 to 262 trips per day. Road improvements currently being constructed would reduce some impacts of this increase.

## 5.3 Alternative 3 — Tailings Impoundment

Alternative 3 contains four options, 3a, 3b, 3c and 3d, concerning tailing impoundments. This alternative was not designed to replace all aspects of the company's proposal, but to focus on the tailing impoundment issue. In theory, any of these options could be inserted into alternatives 2 or 5 to replace the impoundment portion of that alternative. The impacts for the option would replace those of the original impoundment in that alternative.

Two options have already been discussed. Option 3a is the same as no-action alternative 1 and has been discussed in section 5.1 of this chapter. Option 3b is the same as the company's proposal and has been discussed in section 5.2 above.

Option 3c allows the company to increase production to 2000 tpd but would freeze the size of the tailing impoundment. The company would be required to study the impoundment issue and report to the agencies by January 1, 1995 what the company's long range plans are, and how they might be implemented. The major impact of this option is that capacity of the impoundment would be reached in 12 years if no further actions were taken. Mining would then have to cease 10 years earlier than planned or another impoundment would have to be built. All waste rock produced would be used for dam construction, backfill and reclamation. No excess material would be available to build the east side visual berm, so 12 fewer acres would be disturbed. All other impacts to resources would be the same as in the main alternative. Under option 3c, the effects of the existing impoundment would not be changed.

Option 3c increases production to 2000 tpd and, therefore, would most logically be selected with Alternative 2 - the company's proposal or Alternative 5 - proposed action with modifications.

Option 3d allows production of 2000 tpd, but it also increases the capacity of the impoundment so that both of the company's production goals could be reached. Tailing capacity would be increased by raising the height of the dam 14 feet to a total of 155 feet, and by extending the foot of the impoundment an average of 55 feet toward the Stillwater River, thereby enlarging the impoundment 9 acres to total 75 acres. The outside embankment would remain at 2h:1v except along Mountain View Creek. Under option 3d: 1) life of the impoundment would be 17 years until the year 2008; 2) factors of safety concerning mass failure would remain well above standards; 3) the probability of dam failure would exist during the full probable maximum flood (PMF) but that impact would be negligible in relation to the regional flooding which would occur; 4) the embankment slope would be lengthened and enlarged to 62 acres resulting in increased erosion; 5) because the dam would be larger, 250,000 $yd^3$ would have to be borrowed to build the dam; and 6) FAS 419 would have to be relocated. Some of these impacts could be significant.

This option would have no additional effect on water quality or quantity.

The reclamation plan would remain the same so most impacts would be the same. However, because the embankment slope is lengthened, impacts would be the most severe of any alternative. Erosion would increase and soil productivity would decrease.

Extending the embankment toward the river would eliminate the toe dike. Loss of this habitat would adversely affect the bighorn sheep, but not as severely as alternative 2 (option 3b).

Visual impacts would be the largest for all alternatives because of the increased size of the impoundment. It would take a moderate time period to achieve retention of visual quality.

Because option 3d increases production to 2000 tpd, it would be most compatible with alternatives 2 or 5.

## 5.4 Alternative 4 - Water Resources

The options in Alternative 4, like alternative 3 cannot stand alone, but must be incorporated with alternative 2 or 5. These options concentrate on water quality. Option 4a is the no-action alternative and has been discussed in alternative 1. The company's proposal is option 4b and has been discussed as alternative 2.

Option 4c Advanced Water Treatments

Advanced water treatments would maintain nitrate levels in surface and groundwater at existing levels. Other constituents, such as, metals and total dissolved solids would be maintained or improved. SMC would not be required to treat to a better quality than existing surface and groundwater quality.

Wastes such as backwash water, sludge and brines generated by the wastewater treatment would require disposal on or off site depending on the operational status of the tailing impoundment.

Additional electrical power may be necessary depending on the treatment option selected. This may require an upgrade of existing power lines. Depending on the treatment option selected, transport and storage of additional chemical reagents, including strong acids or bases, would be required. Additional personnel would be required to operate these facilities.

If land application of treated adit water stopped, such as is the case with forced evaporation, SMC would be required to withdraw additional surface water to irrigate the area of chrome tails. Otherwise, erosion of these materials would degrade surface water quality.

## 5.5 Alternative 5 - Proposed Action with Modifications

This alternative uses the company's proposal as a base, but then mitigates many of the identified impacts. Impacts would be as previously discussed except as mitigated below.

The first modification could be to select one of the tailing impoundment options. Alternative 3b is the company's proposal but either 3c or 3d could replace it. Whichever option is selected, field tests for consolidation of the tailing must be conducted near the end of impoundment life so that the ultimate amount of settlement can be determined. This would assure optimal contouring of the final reclaimed surface.

Reclamation under all alternatives is considered marginal. Even though SMC is taking steps to improve soil salvage and reclamation, the following mitigation would make reclamation even more successful. This mitigation includes: 1) reviewing soils to identify additional salvage areas and volumes and continuing research by SMC on growth potential of waste products; 2) developing a "mosaic" pattern balancing rock armor and vegetative cover to break up the long slopes of the embankment or other areas; and 3) incorporating trees, boulders, etc. in the mosaic to vary the perceived outline and forms of the impoundment and to help screen some facilities. This mitigation would result in greatly enhanced productivity on all areas to be reclaimed.

Implementing the mosaic portions of the reclamation mitigation on option 3b might be very difficult because the steepness of the slope precludes use of heavy equipment for placement of materials. If the mosaic were not implemented wildlife would not reap the benefits of the varied embankment slope, and aesthetically, variety would be lost.

Implementation of the above mitigations on option 3c and 3d would optimize long-term revegetation success using current technology.

Groundwater monitoring, including the addition of new monitoring wells, would assure maintenance of ambient water quality below the SMC permit boundary. If ambient levels were exceeded, SMC would be required by the agencies to implement a remedial action program that would include treatment or terminating those portions of the operation that are contributing to the degradation. Ambient conditions would be either the existing water quality or those determined by the BHES (Alternative 4b). SMC would not be required to treat to better-than-existing conditions.

The other water quality monitoring requirements are intended to ensure the effectiveness of the proposed mitigation measures and validate the agencies' analytical predictions. The measures would not result in additional water treatment being required.

Wildlife would be favorably impacted by the generally improved reclamation and mosaic pattern. But, in addition, SMC would be required to enter into a cooperative study to evaluate vegetative differences in composition, nutrition and palatability between the toe dike and core winter range. Depending on the study's results, specific habitat improvements would be implemented to draw the bighorns away from the mine. Off-site enhancement would replace the approximately 30 acres of disturbance from this proposal. Results of this mitigation would be reviewed annually by the Coordinated Bighorn Sheep Management Committee.

To aid the agencies in long-range planning, a survey of recreational preferences of employees would be conducted by SMC as employment levels approach 525.

Adverse aesthetic impacts would be reduced by implementing the modified reclamation plan. Variety is the most important aspect of scenic quality and the mosaic pattern on the embankment aptly fits this statement. The long unnatural lines of the dam would be broken, the embankment would be varied and general reclamation would be enhanced. As a result, this alternative would minimize the time necessary to achieve the goal of retention of visual quality. Short term or operating impacts would also be reduced by at least partial visual screening of facilities.

Some impacts of the traffic generated by SMC's proposal would be mitigated in alternative 5. Car-pooling with a 3 person per vehicle goal would be retained. However, employees living within 10 miles of the mine would be exempt. Although overall traffic to the mine would increase, the area

of greatest concern, Fishtail, would be minimally impacted. Because SMC has reached the car-pooling target for 2 years, compliance reporting would be reduced to only 2 months per year.

Continuing employee education concerning stress to wildlife created by stopping and viewing is expected to eliminate potential adverse impacts to the sheep herd from increased traffic.

## 5.6 Conclusions

In conclusion, the greatest impacts from the proposed plan and alternatives are those impacts associated with change in the tailing impoundment. The change in the tailing impoundment raises stability questions and creates secondary effects associated with wildlife, revegetation, aesthetics and other resources. Of the alternatives evaluated, Alternative 2 (3b), the company's proposed plan, and 3d, the modified impoundment would have the greatest adverse effect on the bighorn sheep herd, revegetation and aesthetics. These impacts have the potential to be significant without additional mitigation or modification of the plan. Therefore, if these alternatives (2, 3b, or 3d) were selected, an EIS would likely have to be prepared.

As described above, none of the other associated impacts are considered major. These include water, employment, socio-economic, recreation, wildlife other than the sheep, air quality, and cultural resources impacts.

Impacts, either direct or indirect, associated with Alternatives 1, 3a, 3c, 4 and 5 are not considered to be significant under NEPA (40 CFR 1502.27) and MEPA (ARM 26.2.644) criteria. Therefore, if any of these alternatives were selected by the appropriate decision makers, an environmental impact statement would not be necessary.

The DSL's and Forest Service's preferred alternatives are: Alternative 5 with tailing impoundment 3c and water treatment 4b. This is the company's proposal to increase production to 2,000 tpd and to expand some facilities, but with added mitigation for water monitoring, waste rock monitoring, reclamation, wildlife, traffic and visuals. The tailing impoundment would not be enlarged, and the company would be required to submit a long-range study by January 1, 1995. Water treatment levels would be determined by the BHES at or below the levels requested in SMC's petition.

The Water Quality Bureau (DHES) will prepare a report and recommendations to the BHES after the public comment period closes [ARM 16.20.705(3) and (4)(b)]. This report will be included in the final Environmental Assessment.

## GLOSSARY

| | |
|---|---|
| 2h:1v | Slope angle measurement; slope is twice as long horizontally as vertically; 3h:1v = 18°; 2.25h:1v = 24°; 2h:1v = 27°; 1.6h:1v = 32°; 1.5h:1v = 34° |
| AQB | Air Quality Bureau, Department of Health and Environmental Sciences |
| Clarification | Process of removing suspended particles from water by precipitating them and drawing the sludge off. |
| Concentration | Amount of material contained in a specified volume, or the strength of a solution (mass per volume). |
| Degradation | The increase in concentration of certain regulated substances above ambient (background) levels, and may only be allowed by the BHES based on necessary social and economic concerns. |
| DHES | Montana Department of Health and Environmental Sciences |
| DNRC | Montana Department of Natural Resources and Conservation |
| DSL | Montana Department of State Lands |
| EA | Environmental Assessment - an environmental document of a proposed action and its effects on the environment |
| EIS | Environmental Impact Statement - a comprehensive environmental document delineating a proposed action's effects on natural and human environment. An EIS gives an in-depth look at specific issues and cumulative effects in an area. Required by the federal National Environmental Policy Act (NEPA) and the Montana Environmental Policy Act (MEPA) |
| ESA | Federal Endangered Species Act |
| geotextile | Synthetic material that is used in construction to create desired soil properties and conditions. Geotextiles are used to increase tensile and bearing strength for equipment access, to control water management and flow direction, and are used as filters between materials of varying particle size distribution. |

| | |
|---|---|
| gpd | gallons per day |
| gpm | gallons per minute |
| HDPE | High Density Polyethylene - a high density man-made material used for liners. This material deforms with a low probability of puncturing or splitting. Seams are heat welded instead of glued, thus preventing rupture. |
| LAD | Land application disposal |
| load | Amount of material carried in a specified length of time (mass per time). |
| mg/l | milligrams per liter |
| permeable | A relative property of material that allows for movement of water. Low permeability of impervious material such as clay would allow less water movement than the high permeability of a pervious medium such as sand and gravel. |
| pervious | A quantitative description of the hydraulic conductivity of a material. Hydraulic conductivity, also known as permeability, is a relative measurement of the potential groundwater flow rate through the material. Pervious material has a hydraulic conductivity of greater than 100 feet per year ($1 \times 10^{-4}$ cm/second); semi-pervious material is within a hydraulic conductivity range from 1 to 100 feet per year ($1 \times 10^{-6}$ to $1 \times 10^{-4}$ cm/sec); impervious material has a hydraulic conductivity of less than 1 foot/year ($1 \times 10^{-6}$ cm/sec). |
| pH | Measure of the acidity or alkalinity; 7 is neutral, low numbers are acidic |
| ppm | parts per million |
| SMC | Stillwater Mining Company |
| TDS | Total dissolved solids |
| TSP | Total Suspended Particulate |
| USLE | Universal Soil Loss Equation |
| WQB | Water Quality Bureau, Department of Health and Environmental Sciences |

Water Treatment - Conventional: Means in or of application the processes of coagulation, sedimentation, filtration, and chlorination. If necessary, it may also include taste and odor control and line softening [ARM 16.20.603(4)]. Conventional treatment includes BCT (Best Conventional Pollutant Control Technology) for control of conventional pollutant (BOD, TSS, fecal coliform and pH) and BAT (Best Available Technology) for control of toxic pollutants (40 CFR 125). In addition to the technologies above, conventional treatment includes: secondary settling, pH adjustment, clarification, complete recycle and reagent substitution. Conventional treatment meets the minimum treatment standards as defined in ARM 16.20.631(3).

Water Treatment - Advanced: Means any water treatment process that removes more contaminants from wastewater than treatments which are in general use. Contaminants removed by advanced treatment include: suspended solids, dissolved organic compounds, and dissolved inorganic materials (including nutrients). Advanced treatment may include: advanced filtration, electrodialysis, ion exchange, reverse osmosis, and biological treatment.

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